Appendix 1

Detailed response by the RSPB to the Environment Agency's 'minded to' decision on licence renewal applications to extract water from Plumsgate Lane and Ludham Road boreholes

1. Introduction

The RSPB

1.1 The Royal Society for the Protection of Birds (RSPB) is a wildlife conservation charity supported by a subscribing membership of over one million people, of whom some 1,639 live in the Broads where the two abstraction licence renewals will be in use. We seek to influence society, including Government, to encourage the adoption of environmentally sustainable policies and practices which embrace economic, social and environmental objectives. Conservation of biodiversity is regarded as a key test of sustainability. We seek to ensure that our views are informed by sound scientific understanding and policy analysis. We safeguard and enhance biodiversity more directly through the acquisition and management of land as nature reserves. We currently own or manage 212 reserves, extending over 150,000ha of land, of which 2 sites are located within the proximity of the two abstraction licence renewals.

The RSPB's interest in the Catfield area

Sutton Fen

1.2 The RSPB has been involved in the management and conservation of Sutton Fen since purchasing the site in 2006. Sutton Fen forms a continuous and extensive area of nationally rare and internationally important fen habitat, including large areas of national scarce saw sedge beds. The site is an integral part of the Ant Broads and Marshes Site of Special Scientific Interest (SSSI) and is exceptionally important for its rare plants and diversity of invertebrates present, such as fen orchid and crested-buckler fern. It also supports four breeding pairs of marsh harrier, two bittern territories, occasional nesting and wintering cranes, up to sixteen roosting marsh harriers and eight wintering hen harriers. Cetti's warblers, reed buntings, bearded tits and a range of other wetland birds listed on the SSSI citation also breed and winter on the site.

Catfield Fen

1.3 The RSPB has been managing part of Catfield Fen on behalf of Butterfly Conservation since 2013. We have invested considerable resource in restoring the site from scrub encroachment; one of the reasons for the site condition to have been classified as Unfavourable Recovering in the 2013 Condition Assessment. We have also invested in updated surveys to investigate changes in the vegetation community, water chemistry and water beetle assemblage across the site. Our key objective is to ensure that factors adversely affecting the site and causing significant deterioration are addressed. Whilst we

will look at all options regarding site management, any works will be ineffective in reverse the site deterioration if underlying issues such as reduced groundwater inputs are not addressed.

Fen orchid

1.4 Across both Sutton and Catfield Fens, the RSPB has responsibility for managing over 90% of the UK's fen orchid population, a species listed on Annex II of the EU Habitats Directive (this includes consideration of both fen and dune sub-species of this rare plant). Fen orchid requires the appropriate alkaline conditions to create and maintain the appropriate calcareous fen community that it depends on to grow. The observed changes across the site are placing over 50% of the UK fen orchid population at risk. Maintenance of the Catfield Fen population is therefore critical to securing its long term survival in the UK.

2. Legal and policy framework for the conservation of statutorily designated nature conservation sites and biodiversity

Introduction

2.1 The following sections sets out the RSPB position regarding the legal and policy frameworks governing the Catfield case. We recognise that the Environment Agency has set this out in Section 3 of the Appendix 12 & Section 15 of the draft determination report, but the RSPB considers that in some areas (e.g. application of the Habitats Regulations and EU Water Framework Directive) a stronger interpretation/approach should be applied in the case of the Catfield case.

2.2 For clarity the RSPB's comments relate to the duties on the Environment Agency in respect of the conservation of:

- Broadland Special Protection Area (the SPA);
- The Broads Special Area of Conservation (the SAC);
- Broadland Ramsar site (the Ramsar site); and
- Ant Broads and Marshes SSSI (the SSSI).

Purpose of the Nature Directives

2.3 As noted above, all SPAs and SACs are protected formally under the EU Habitats and Birds Directives, implemented in England by the Conservation of Habitats and Species Regulations 2010 (as amended) ('the Habitats Regulations').

2.4 The legal basis for EU competence in the environment field was established in the 1970s, following the Stockholm environment summit. It was considered that no country should be able to gain an economic advantage over another through adoption of lower environmental standards – especially where this might put a common resource, such as water, at risk.

2.5 The Birds Directive took specific action for rare, vulnerable and threatened species, as well as migratory birds as the latter represented a common European heritage where loss of habitat in one country could have knock-on effects on the bird populations of another. The Habitats Directive later extended a similar approach to cover other flora, fauna and habitats of European importance. It created the EU-wide Natura 2000 network of protected areas, comprising SACs under the Habitats Directive and SPAs under the Birds Directive.

2.6 The purpose of both Directives is to maintain at, and where necessary restore to, favourable conservation status flora, fauna and habitats of European importance. In simpler language, they aim to create healthy and prospering populations and habitats that have good prospects to remain that way in the future. Conserving the Natura 2000 network is one of the cornerstones of achieving this goal and is central to the achievement of the EU's biodiversity policy.

Duties in respect of European and internationally important sites

2.7 The main protective provisions in respect of SPAs, SACs and Ramsar sites are set out in the Habitats Regulations. The Habitats Regulations transpose, for the most part, the requirements of the Habitats Directive into British law. Articles 6(2) to 6(4) of that Directive set out the main protection regime that must be applied to SPAs and SACs.

2.8 Regulations 61, 62 and 66 of the Habitats Regulations transpose the protective regime of Articles 6(3) and 6(4) for most plans or projects. These regulations set out the main tests that the competent authority would have to apply to any plan or project likely to have a significant effect on European Sites i.e. SPAs and/or SACs[1]. It is Government policy (paragraph 118 of the National Planning Policy Framework (NPPF)) that the same protection is afforded to listed and proposed Ramsar sites.

2.9 Policy guidance on the interpretation of these legal requirements can be found in national[2] and European[3] guidance documents.

2.10 Given that the abstraction licences are not directly connected with or necessary for the management of a European site, it is necessary to consider them against the sequence of steps set out in the Habitats Regulations to be taken by the competent authority when considering authorisation for a project that may have an impact on a European site before deciding to authorise that project.[4] These are as follows:

i. **Step 1:** Under regulation 61(1) (b), consider whether the project is directly connected with or necessary to the management of the European Site(s). If not –

ii. **Step 2:** Under regulation 61(1)(a) consider, on a precautionary basis, whether the project is likely to have a significant effect on the European Site(s), either alone or in combination with other plans or projects (the LSE Test).

iii. **Step 3:** Under regulation 61(1), make an appropriate assessment of the implications for the European Site(s) in view of its conservation objectives. Regulation 61(2) empowers the competent authority to require an applicant to provide information for the purposes of the appropriate assessment. There is no requirement or ability at this stage to consider extraneous (non-conservation e.g. economics, renewable targets, public safety etc) matters in the appropriate assessment.

iv. **Step 4:** Pursuant to regulation 61(5) and (6), consider whether it can be ascertained that the project will not, alone or in combination with other plans or projects, adversely affect the integrity of the European Site(s), having regard to the manner in

[1] Protection extended to cSACs by virtue of Regulation 8.

[2] ODPM Circular 06/2005 Biodiversity and Geological Conservation – statutory obligations and their impact within the planning system.

[3] European Commission (2000) Managing Natura 2000 sites: the provisions of Article 6 of the Habitats Directive 92/43/EEC and European Commission (2007/2012) Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC.

[4] This should be read in conjunction with Regulation 99 (abstraction and works authorised under water legislation) of the Habitats Regulations which is applied by Regulation 60(1) to the general provisions set out in Regulation 61 *et seq*.

which it is proposed to be carried out, and any conditions or restrictions subject to which that authorisation might be given (the Integrity Test).

v. **Step 5:** In light of the conclusions of the assessment and in accordance with regulation 61(5) and (6), the competent authority shall agree to the project only after having ascertained that it will not adversely affect the integrity of the European Site(s), alone or in combination with other plans or projects.

vi. **Step 6:** A competent authority may only derogate from Regulation 61 where there is an absence of alternative solutions, and it is satisfied that there are imperative reasons of public interest that override the protection of the European Site(s) and that compensatory measures have been secured that protect the overall coherence of the Natura 2000 network (Regulations 62 and 66). If there are less damaging alternative solutions, no derogation is permitted and consent must be refused.

2.11 The tests set out in Regulations 61, 62 and 66 are extremely strict as they concern the protection of sites that are of recognised European and international importance. Relevant effects on a site may be direct (e.g. direct loss of habitat) or indirect (e.g. change to water chemistry due to reduced groundwater inputs). They may also arise from operations outside the boundary of a site e.g. changes to drainage systems. The extent to which any such effects can be removed or reduced by mitigation measures will vary.

2.12 Where it is not possible to conclude there will be no adverse effect on a site, it is necessary to consider whether there are alternative solutions. European Commission guidance states that this must examine whether there are alternatives to the plan or project that better respect the integrity of the site in question i.e. are there alternatives that are less damaging to the SPA, SAC or Ramsar site? Such alternatives could include different designs, locations or even policy approaches that meet the public interest objectives of the plan or project.

2.13 If no such alternatives exist, it would then be necessary to assess whether there are imperative reasons of overriding public interest (IROPI). The grounds for derogating from the protective provisions of the Habitats Directive must be exceptional and not every kind of public interest will be sufficient when weighed against the objectives of the Directive.

2.14 If IROPI is demonstrated, compensatory measures must be secured to protect the coherence of the Natura 2000 network, targeted at the features and supporting ecological functions that are adversely affected. The European Commission has set out more detailed guidance on this matter.[5]

2.15 In order to meet the various tests set out above, it is incumbent upon the applicant to provide sufficient evidence to demonstrate there are no alternative solutions and IROPI can be proven.

[5] http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/new_guidance_art6_4_en.pdf

Alternative solutions

2.16 In considering alternative solutions, it is essential to define the high level public interest objectives any plan or project would be contributing towards e.g. achieving a water efficient economy now and in long-term.

2.17 The test on alternative solutions is therefore wider than just consideration of alternative abstraction options. Essentially, to pass this test a plan or project would need to show:

- it must go ahead at that particular location and that no other location(s) and/or solution(s), either locally or nationally, could address its contribution to the public need; and critically
- that there were no less damaging alternative solutions to the plan or project that meet or contribute to the public interest objectives (e.g. alternative water sources, types of crops, sources of crops grown in less damaging locations).

2.18 A consideration of alternative solutions should therefore explore:

- Firstly, the full range of credible and feasible alternative solutions to meet the public interest objectives;
- Secondly, assess the impacts of those alternative solutions on European sites;
- Thirdly, compare the impacts of those alternative solutions on European sites to the predicted impacts of the Catfield water abstraction licence renewals.

Imperative reasons of overriding public interest and compensatory measures

2.19 Should the Environment Agency decide there are no less damaging alternative solutions to meeting the public interest objectives, it will be necessary for the Environment Agency to assess whether the damage to European sites can be justified in the overriding public interest. This would require a systematic analysis to demonstrate where the balance of public interest lies in the context of the need to conserve the interests of the European sites.

2.20 If it is decided that the IROPI test can be met, then the Environment Agency will need to consider whether the necessary compensatory measures can be secured to protect the overall coherence of the Natura 2000 network.

Duties in respect of nationally important sites

2.21 Catfield Fen and Sutton Fen are highly protected under European and International law for the habitats and species that they support. They are also designated as SSSIs. Sites of Special Scientific Interest (SSSI).

2.22 SSSIs are the most important sites for national wildlife and natural features in England. In England, SSSIs are notified by Natural England under Section 28 of the Wildlife and Countryside Act 1981 (as amended) (the WCA) to notify SSSIs where it is of the opinion that an area of land is of special interest by reason of any of its flora, fauna, or geological or physiographical features and to secure their day-to-day protection and conservation.

2.23 The purpose of SSSIs is defined in the Defra Code of Guidance[6] (paragraph 1) as being:

"*…to safeguard, for present and future generations, the diversity and geographic range of habitats, species, and geological and physiographical features, including the full range of natural and semi-natural phenomena throughout England*..."

2.24 SSSIs make a fundamental contribution to the ecological processes upon which we all depend and to human quality of life. Individual SSSIs may also provide, or safeguard for the future, valuable research, educational and amenity resources.

2.25 Under Section 28G(2) of the WCA, public bodies must:

"*…take reasonable steps, consistent with the proper exercise of the authority's functions, to further the conservation and enhancement of the flora, fauna or geological or physiographical features by reason of which the site is of special scientific interest*".

2.26 The duty applies to all SSSIs and is in addition to those duties described above in respect of SSSIs also designated as SPAs, SACs or Ramsar sites.

2.27 The Defra Code of Guidance (paragraph 73) states that the Secretary of State expects that all public bodies will take full account of their responsibilities under this duty whenever their actions may affect SSSIs. Government Circular 06/2005[7], paragraph 61 requires all section 28G authorities, including local planning authorities, to apply strict tests when carrying out any functions within or affecting a SSSI, to ensure that they avoid or at least minimise adverse affects. It also requires public bodies, which includes the Environment Agency, to take positive steps wherever possible to conserve and enhance the special interest features of a SSSI where their activities may be affecting it or as opportunities arise in the exercise of their functions.

The Natural Environment and Rural Communities Act 2006

2.28 Section 40 of the Natural Environment and Rural Communities Act 2006 sets out a public authority duty to conserve biodiversity. It states that:

"*Every public authority must, in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity*."

Duties in respect of wild bird habitat

2.29 The RSPB wishes to highlight that compliance with Regulation 9 of the Habitats Regulations is required. Regulation 9A(1) of the Regulations provides:

"(1) Without prejudice to regulation 9(1), the appropriate authority, the nature conservation bodies and, in relation to the marine area, a competent authority must take such steps in

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[6] Defra (2003): Sites of Special Scientific Interest: Encouraging Positive Partnerships.

[7] Government Circular 06/2005: Biodiversity and geological conservation – statutory obligations and their impact within the planning system, 16 August 2005.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7692/147570.pdf.

the exercise of their functions as they consider appropriate to secure the objective in paragraph (3), so far as lies within their powers.

(2) Except in relation to the marine area, the Environment Agency, the Forestry Commissioners, local authorities, the Broads Authority and National Park authorities must take such steps in the exercise of their functions as they consider appropriate to contribute to the achievement of the objective in paragraph (3).

(3) The objective is the preservation, maintenance and re-establishment of a sufficient diversity and area of habitat for wild birds in the United Kingdom, including by means of the upkeep, management and creation of such habitat, as appropriate, having regard to the requirements of Article 2 of the new Wild Birds Directive...

...(7) In considering which measures may be appropriate for the purpose of securing or contributing to the objective in paragraph (3), appropriate account must be taken of economic and recreational requirements."

2.30 In addition Regulation 9A(8) provides that:

"So far as lies within their powers, a competent authority in exercising any function in or in relation to the United Kingdom must use all reasonable endeavours to avoid any pollution or deterioration of habitats of wild birds (except habitats beyond the outer limits of the area to which the new Wild Birds Directive applies)".

Duties with respect to the Water Framework Directive

2.31 The Environment Agency is the competent authority in England for the Water Framework Directive (WFD), with a general duty to 'secure compliance' with the Directive under the 2003 Water Environment Regulations. This involves the preparation of summary River Basin Management Plans on a six-yearly cycle, but more importantly a commitment to act in ways that meet the core aims and requirements of the WFD.

2.32 These aims are set out in Article 1 of the WFD, as 'the protection of inland surface waters, transitional waters, coastal waters and groundwater', in a way which:

(a) prevents further deterioration and protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems;
(b) promotes sustainable water use based on a long-term protection of available water resources
(d) ensures the progressive reduction of pollution of groundwater and prevents its further pollution,.

2.33 The specific targets set by the Directive for meeting these targets, include under Article 4 the requirements to 'achieve compliance with any standards and objectives' set for protected areas – including Natura 2000 sites – and to 'protect, enhance and restore all bodies of groundwater, ensure a balance between abstraction and recharge of groundwater'. Both of these are necessary by December 2015, although the latter target can be delayed in cases where an abstraction has markedly greater environmental, social and economic benefits than it has costs.

2.34 Elsewhere in the WFD, there are requirements for both universal 'basic measures' and site-specific 'supplementary measures' to protect surface and groundwaters from damage (Article 11) – including regulatory controls – and for the recovery of costs from those causing environmental or social damage unless other measures are in place to restore the damage (Article 9).

2.35 Overall, the WFD sets a clear direction that 'Water is not a commercial product like any other but, rather, a heritage which must be protected, defended and treated as such', and that competent authorities are bound in every decision to ensure sustainable and ecologically sound use of water.

3. Nature Conservation importance of Catfield Fen and Sutton Fen

Introduction

3.1 The Catfield area supports a number of sites that are highly protected for the suite of habitats and species that they support (Figure 3.1). These designations all cover Catfield Fen (SSSI Unit 3 owned by Butterfly Conservation and managed by RSPB) and Sutton Fen (SSSI Unit 10 owned and managed by the RSPB). The location of these sites and ownership is presented in Figure 9.2 of the draft determination report. The habitats and species these sites support are of international importance, with both sites contributing to the view that this SSSI supports some of "...*the finest examples of unpolluted valley fen in Western Europe*" (Ant Broads and Marshes SSSI citation, 1989).

3.2 The Appendix 12 and Appendix 4 that support the draft determination report present a full overview of these sites and the features for which the sites are designated. The RSPB briefly comments on the key sites and their features. Key features pertinent to the Catfield case are then discussed in detail.

European and internationally important sites

The Broads Special Area of Conservation (SAC)

3.3 The Broads SAC was designated in 2005 and the Standard Data Form updated in 2011. This updated citation lists the following habitat types and species as being of European importance and meeting the criteria for SAC designation:

- Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.
- Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation.
- *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*).
- Transition mires and quaking bogs.
- Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*.
- Alkaline fens.
- Alluvial forests with Alnus glutinosus and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae).
- Vertigo moulinsiana.
- Triturus cristatus.
- Lutra lutra.
- Liparis loeselii.
- Anisus vorticulus.

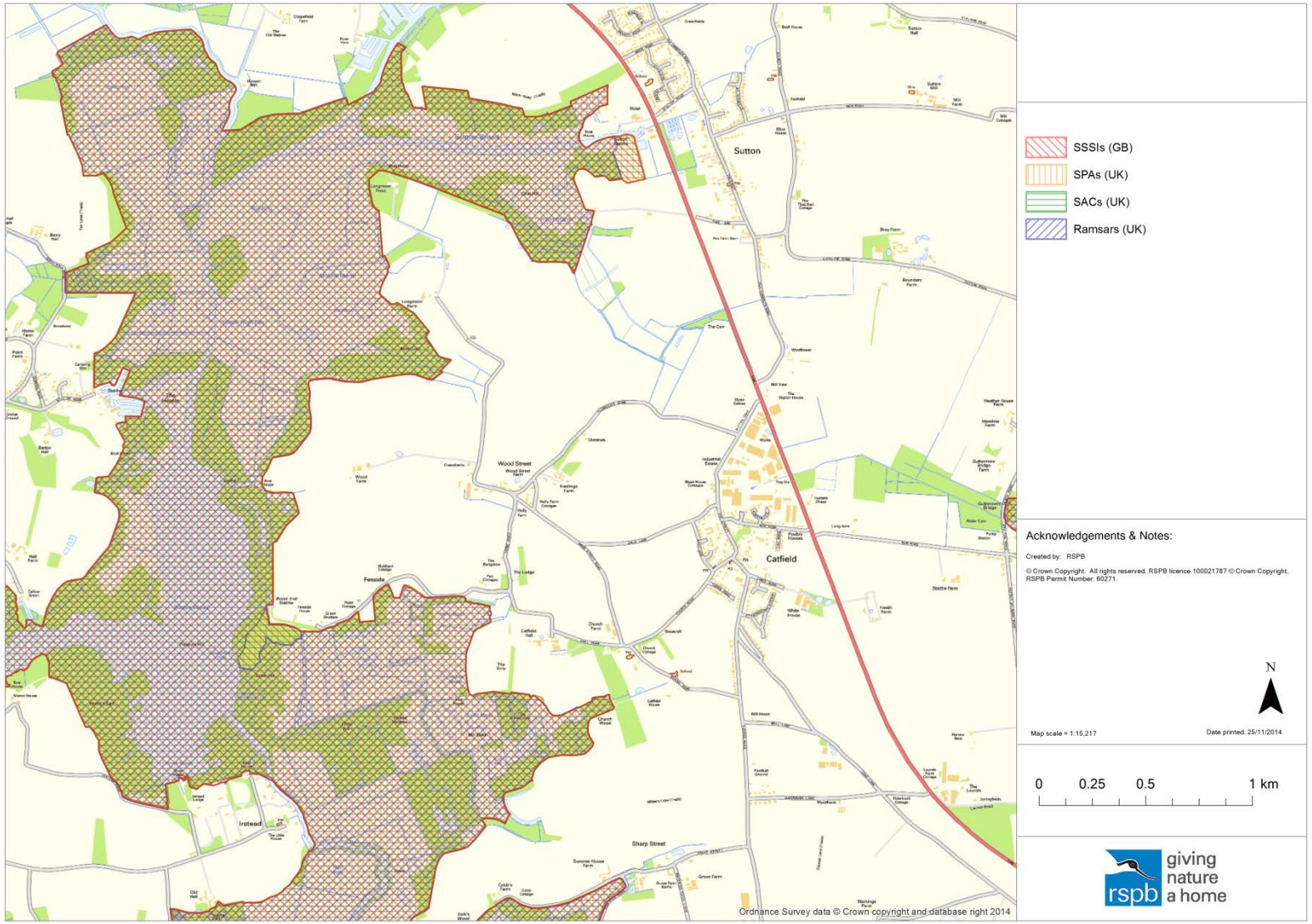


Figure 3.1: Map showing the designated sites within the vicinity of Catfield Fen. The map clearly shows that the whole of SSSI Unit 3 is fully protected at European and International level.

3.4 The site is underpinned by a number of SSSIs, including the Ant Broads and Marshes SSSI. This provides an indication of the changing condition of the site and reviews maintenance of overall site integrity. The evidence presented to date to the Environment Agency and Natural England highlights a number of concerns regarding changing hydrological conditions on the site and detrimental changes to the ecological communities on SSSI Unit 3. The recent amendment by NE to the condition status of SSSI Unit 3 reflects these concerns and highlights that a number of factors are adversely affecting the site. This has consequences for the integrity of The Broads SAC given that fen orchid and the invertebrate communities, as well as calcareous fen, are being lost from the site (see below for greater detail on fen orchid and aquatic coleoptera).

The Broads SAC features present within Catfield Fen

3.5 All of Catfield Fen (24ha) SSSI Unit 3 sits within the Broads SAC area and the site supports (or recently supported) five SAC Annex I Habitats:

- 7210 Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*,
- 6410 Molinia meadows on calcareous, peaty or clayey-silt laden soils (*Molinion caeruleae*)
- 7140 Transition Mires and Quaking Bogs
- 3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp and
- 3150 Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation.

3.6 There is approximately 18.5ha of open fen on Unit 3. Detailed NVC mapping has not been carried out in recent years. However, approximately 11.6ha is known to be S24[8] vegetation and 4.8ha is S2. Parts of the S24 and all of the S2 communities on Unit 3 qualify as the SAC Calcareous Fen feature where *Cladium mariscus* is dominant. The remaining open vegetation is mostly a mix of S4 reedswamp and BS5 (*Sphagnum*-dominated S24). The latter may qualify as the SAC Transition mire feature. There are also small patches of apparent M24 vegetation that were not recorded in the 2010 Broads Authority survey due to their very localised nature. These areas may qualify as the SAC *Molinia* meadow feature though further targeted survey is required to confirm. No S27 or M9 vegetation is known from Unit 3, though it may have occurred in the past and may have potential for restoration.

3.7 There is an extensive dyke network at Unit 3 and these qualify for the SAC Natural eutrophic lakes feature. In the recent past (within 10 years) there have been *Chara* dominated shallow pools on Unit 3 that qualified as the SAC Hard oligo-mesotrophic waters feature. However recent informal surveys have found these pools to lack large stands of *Chara* and they may no longer support the feature.

[8] Glossary of NVC community/sub-community names and codes available from JNCC at http://jncc.defra.gov.uk/page-4264

The Broads SAC present within Sutton Fen

3.8 147.5ha of the wetland area of Sutton Fen (SSSI Units 8, 10 and 24) sits within the broads SAC and supports five SAC Annex I Habitats:

- 7210 Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*
- 6410 *Molinia* meadows on calcareous, peaty or clayey-silt laden soils (*Molinion caeruleae*)
- 7140 Transition Mires and Quaking Bogs
- 3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp and
- 3150 Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation.

3.9 There is approximately 96.7ha of open fen within SSSI units 8, 10 and 24 (Sutton Fen). Detailed NVC mapping has not been carried out in recent years. However, approximately 77ha is known to be S24 vegetation and 14.0ha is S2 vegetation (Catfield Fen 2013 – 2018 management plan). Parts of the S24 and all of the S2 communities at Sutton fen qualify as the SAC Calcareous Fen feature where *Cladium mariscus* is dominant. The remaining open vegetation is mostly a mix of recovering fen following scrub removal and S26, S4, S7, S28 and S25 which are not SAC features. There are small areas of M24 (totalling <2ha) that may qualify as the SAC *molinia* meadows feature and there are also small patches of BS5 (totalling <2ha) that may qualify as the SAC transition mire feature. The upland fringes of Sutton Broad may support S27 and M9 vegetation and therefore may form part of the SAC transition mire feature. There is an extensive dyke network on units 8, 10 and 24 and both small and large bodies of open water that qualify for the SAC Natural eutrophic lakes feature. There are currently extensive areas of wet open fen and both old and recent turf ponds supporting *Chara* that qualify for the SAC Hard oligo-mesotrophic waters feature.

Broadland Special Protection Area (SPA)

3.10 The Broads SPA was designated in 1994, and was extended in 1998. Further extensions are being considered by Natural England for the Yare valley and Halvergate Marshes components of the site.

3.11 The site citation highlights the following species as being of European importance and meeting the criteria for SPA designation:

- *Botaurus stellaris* - Great bittern (Breeding)
- *Cygnus columbianus bewickii* - Bewick's swan (Non-breeding)
- *Cygnus Cygnus* - Whooper swan (Non-breeding)
- *Anas penelope* - Eurasian wigeon (Non-breeding)
- *Anas strepera* - Gadwall (Non-breeding)
- *Anas clypeata* - Northern shoveler (Non-breeding)
- *Circus aeruginosus* - Eurasian marsh harrier (Breeding)
- *Circus cyaneus* - Hen harrier (Non-breeding)
- *Philomachus pugnax* - Ruff (Non-breeding)

3.12 The RSPB accepts that the majority of the designated features of the SPA will not be affected directly by the changing hydrological regime at Catfield Fen SSSI Unit 3. However, much of the site has become unfavourable for bittern feeding and breeding because it is too dry. Bitterns used to breed, but have not been recorded on site since 2011. The area can be important for foraging bittern during the winter and lowered water levels could reduce foraging opportunities for this species. Bittern has not been considered a priority species for assessment in the Catfield case given populations are healthy elsewhere in SPA. However, they remain a feature of the SPA and must be dealt with appropriately in the assessments.

Broadland Ramsar site

3.13 The Broadland Ramsar was designated in 1994. The site broadly coincides with the Natura 2000 site designations and nationally important SSSIs. Catfield Fen forms an important component of this site and key features that have made the site important at a national and European level are also of international importance. Features at Catfield Fen that are particularly important to the Ramsar designation are:

- H7210 Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* Calcium-rich fen dominated by great fen sedge (saw sedge);
- S1016 *Vertigo moulinsiana* Desmoulins's whorl snail;
- S1903 *Liparis loeselii* Fen orchid.

3.14 Section 14 of the Broadland Ramsar Information Sheet notes the site supports: "...*outstanding assemblages of rare plants and invertebrates including nine British Red Data Book plants and 136 British Red Data Book invertebrates.*" Table 3.1 below highlights the nationally rare and scarce plants found at Catfield Fen SSSI Unit 3 that are features of the Ramsar site.

Table 3.1: List of nationally rare or scarce higher plants identified as features of the Broadland Ramsar site that occur at Catfield Fen SSSI Unit 3

Species	Common name	RDB Status	Presence on SSSI Unit 3	Presence on SSSI Units 10, 24 and/or 8
Liparis loeselii	Fen orchid	UK Endangered EU Near Threatened	Over 50% of the known UK population is found on SSSI Unit 3.	Over 40% of the known UK population is found on SSSI Unit 10.
Najas marina	Holly-leaved naiad	Vulnerable	Last recorded in 2011 in turf pond, not refound in 2014 during search of previous colony	Not known
Dryopteris cristata	Crested buckler-fern	Critically Endangered	Occurs across SSSI Unit 3	Occurs in 3 colonies on Unit 10, holding over 500 plants. 1 plant known from unit 8.
Dactylorhiza traunsteineri	Narrow-leaved marsh-orchid	Least concern	Not known from SSSI Unit 3	Occurs occasionally on Unit 10

Species	Common name	RDB Status	Presence on SSSI Unit 3	Presence on SSSI Units 10, 24 and/or 8
Potamogeton compressus	Grasswrack pondweed	Data Deficient	Not known from SSSI Unit 3	Recorded historically from Unit 10, but not re-found during recent surveys.
Pyrola rotundifolia	Round-leaved wintergreen	Least concern	Occurs on Unit 3, scattered, 10 colonies known.	Occurs in 5 colonies scattered across Unit 10,. One colony consists of over 500 plants.
Sonchus palustris	Marsh sow-thistle	Least concern	Not known from SSSI Unit 3	Occurs occasionally on banks on Unit 10
Cicuta virosa	Cowbane	Least concern	Occurs on Unit 3. It is frequently found on ditch edges, but is rare in wetter areas of open fen.	Occurs frequently throughout Units 10 and 24 and occasionally on Unit 8.
Carex appropinquata	Fibrous tussock-sedge	Near Threatened	Occasional in wetter areas across SSSI Unit 3	Occurs frequently in parts of Unit 10 (Sutton Broad) and occasionally elsewhere on units 8,10 and 24
Thelypteris palustris	Marsh fern	Least concern	Frequent and locally abundant on Unit 3	Frequent and locally abundant throughout Units 8, 10 and 24
Potamogeton coloratus	Fen pondweed	Least concern	Previously recorded on SSSI Unit 3 but now appears to be replaced by *Potamogeton polygonifolius* (bog pondweed). See Parmenter 2014.	Occurs in occasional areas of very wet fen in Unit 10 and 24. Not known from Unit 8.
Sium latifolium	Greater water-parsnip	Endangered	Occasional across SSSI Unit 3 in wetter areas and frequently on ditch edges	Occurs frequently across units 8,10 and 24.
Stratiotes aloides	Water-soldier	Near Threatened	Occurs throughout the ditch network on SSSI Unit 3, mostly on landward edges	Occurs on one ditch in Unit 10, Not known from Units 8 or 24

3.15 Across SSSI Unit 3, there is also a diverse invertebrate community. The limited number of surveys undertaken have highlighted the site is one of the best in the UK for many rare and scarce species. For example, SSSI Unit 3 supports swallowtail butterfly and Norfolk hawker dragonfly populations, as well as small dotted footman moth[9]. Of particular note is the aquatic coleoptera community that is present. 22 Red Data Book species have been recorded on the site, and it is considered one of, if not the best, site in the UK for this

[9] Lott, D.A, Drake, C.M., Lee, P. (2010). *Broads fen Invertebrate Survey*. Arachne Invertebrate Information Services.

species group. More detail on the aquatic coleoptera importance is provided in paragraphs 3.42-3.46 below and Appendices 5 and 6.

3.16 The site conservation objectives are determined by the management plans for the Natura 2000 and SSSI sites that underpin the Ramsar site. The conservation objectives are therefore the same as those highlighted within the Appendix 12.

3.17 The RSPB considers that Ramsar sites must be treated the same as SAC and SPA sites. This reflects that the site is of international importance and is enshrined in Government policy (see paragraph 2.8 above).

Nationally important sites

Ant Broads and Marshes Site of Special Scientific Interest (SSSI)

3.18 The Ant Broads and Marshes SSSI was designated in 1987 and is considered to contain some of the best pieces of lowland fen in Western Europe. Section 3.3 of Appendix 12 (Appropriate Assessment) report reviews the site citation stating that:

"*The Ant Broads and Marshes SSSI is a component of The Broads SAC and Broadland SPA and Broadland Ramsar. Covering an area on the east and west banks of the River Ant it extends for approximately 5.5km down river from the southern edge of Stalham to an area approximately 2km to the north of Ludham Bridge (NGR: TG 3719 1706). The range of supporting habitats includes dykes, fen, reedbeds, carr woodland and open broads. The Ant Broads and Marshes SSSI comprises nine hydrological sub areas...*

The floodplain of the middle Ant valley, one of the five principle river valley systems constituting the Broadland area, supports one of the most extensive remaining areas of undeveloped primary fen habitats in Britain, and is considered to form the finest example of unpolluted valley fen in Western Europe."

3.19 The site is important for a number of different vegetation communities (Calcareous fen with *Cladium mariscus*, *Molinia* meadow on calcareous, peaty or clayey-silt laden soils and 'Transition Mire and Quaking Bogs'), as well as the number of breeding birds and invertebrates (butterflies, moths, beetles, flies, molluscs and spiders) that the site supports. Of particular note is the aquatic coleoptera community, of which the citation highlights that the pools within the fen habitat:

"...*are of exceptional interest for their aquatic coleoptera (water-beetles), and indeed the site is considered to be the most important in Britain for this group. The many rare relict fen species present are indicative of an undisturbed post-glacial history, and include* Agabus striolatus, Hydranea palustris *and* Hypdroporus scalescirius."

3.20 These communities have evolved largely in isolation from river water inputs, resulting in a supply of base-rich, nutrient poor water dictating the water chemistry of the site.

3.21 Features for which the site has been notified are:

- Assemblages of breeding birds - Lowland open waters and their margins
- Invertebrate Assemblage

- Lowland ditch systems
- M24 - Molinia Caerulea - Cirsium Dissectum Fen-Meadow
- M5 - Carex rostrata - Sphagnum squarrosum mire
- M9 - Carex rostrata - Calliergon cuspidatum/giganteum (Calliergonella cuspidata/Calliergon giganteum) Population of Schedule 8 plant - Liparis loeselii, Fen Orchid mire
- S2 - *Cladium mariscus* swamp and sedge-beds
- S24 - Phragmites australis - Peucedanum palustris tall-herb fen
- S27 - Carex rostrata - Potentilla palustris swamp
- Standing waters
- Vascular Plant Assemblage
- W2 - Salix cinerea - Betula pubescens - Phragmites australis woodland
- W5 - Alnus glutinosa - Carex paniculata woodland
- W6 - Alnus glutinosa - Urtica dioica woodland

3.22 Key features pertinent to SSSI Units 3 (Catfield Fen) and Units 8, 10, and 24 (Sutton Fen) have been addressed above and in Appendix 2.

3.23 The site citation highlights that:

"*Past management coupled with local hydrological and substrate variations has resulted in the development of the most diverse pattern of fen vegetation of all the Broadland valleys, and provides the only known sites for several plant communities and uncommon species that were once more widespread in Broadland*."

3.24 This statement highlights the importance of maintaining appropriate hydrological regimes within the SSSI and indicates that local variation of the hydrology is important in dictating the presence and maintenance of certain species. Unfortunately, as highlighted by the Broads Biodiversity Audit[10], the Ant valley is now also seen as a hotspot for the loss of species from the Broads. Many of the lost species, as highlighted on the SSSI citation, will have been specialists, with many occurring either solely within the Broads or in very few other locations across the UK.

Revised condition of the Ant Broads and Marshes SSSI

3.25 The site has been assessed at regular intervals by Natural England and its predecessor English Nature to ensure that appropriate management is in place to maintain the site in favourable condition. Where the site has failed to meet favourable condition status, appropriate measures have been agreed to address factors causing site deterioration. Over time, scrub encroachment has been considered a significant threat and considerable resource has been applied to the site in an effort to tackle the threat as effectively as possible.

[10] Panter, C.J., Mossman,H.L., Dolman, P.M. (2011). *Biodiversity Audit and Tolerance Sensitivity Mapping for The Broads*. Broads Authority, Norwich.

3.26 Since the late 1990s, however, there have been growing concerns that the site has also been threatened by a changing hydrological regime. This has raised concerns regarding the appropriateness of water abstraction activity close to Catfield Fen. The history of these concerns is documented in the draft determination report.

3.27 In October 2014, NE amended their condition assessment of SSSI Unit 3 to unfavourable declining condition (Figures 3.2 and 3.3, Tables 3.2). The identified reasons for adverse condition are:

- Freshwater – water abstraction;
- Inappropriate scrub control;
- Other (this should be confirmed with Natural England, but is understood to be change in habitat suitable for fen orchid).

3.28 Whilst condition assessments are typically carried out on a six year cycle it is noteworthy that the condition of Catfield Fen has received assessment on a more regular basis in recent years. This has been stimulated by the water abstraction case and the need for Environment Agency to have clear advice from Natural England regarding the condition of the site and potential links between water abstraction and ecological changes on the site. In 2013 following additional surveys and monitoring by the RSPB on SSSI Unit 3 additional information on the status of the fen orchid colony and *Sphagnum* species development, Natural England were asked to review the information and confirm to the Environment Agency the implications regarding the Catfield case. The 2013 condition assessment had identified a threat from hydrological change on SSSI Unit 3. However, the condition assessment had not covered the fen orchid colony. Based on the supplementary information provided by the RSPB and contained in Parmenter (2014)[11], Natural England considered there was sufficient evidence to demonstrate that SSSI Unit 3 is in unfavourable declining condition and reclassified the unit in October 2014.

3.29 The RSPB notes that Natural England's view that SSSI Unit 3 should be re-classified to unfavourable declining is noted (page 9 of the Addendum to the Appropriate Assessment), but at the time the amendment had not been made. Given the reasons for this change in condition assessment, the RSPB recommends that the Environment Agency consult Natural England regarding their view that Catfield Fen is being is in declining condition and that water abstraction cannot be ruled out as a potential cause.

3.30 The SSSI condition assessment underpins consideration of impacts adversely affecting the features of the SAC and Ramsar site. This is important given features such as Calcareous Fen and fen orchid are highly sensitive to even small changes in water chemistry, levels and flow.

3.31 The RSPB and Butterfly Conservation acknowledge that one of the threats (inappropriate scrub control) is something that is necessary to address on site. Efforts to address this and evidence to date regarding the effectiveness restoring the calcareous fen following scrub

[11] Parmenter, J. (2014). *Condition Assessment at Catfield: consideration of recent trends in Potamogeton and Liparis in Unit 3*. The Landscape Partnership.

removal and turf pond creation are detailed in section 4 of the RSPB's response. However, we are not able to address the threat from water abstraction. This is entirely outside of our control and requires appropriate steps to ensure water use adjacent to the site is appropriate given the sensitive nature of the designated features.

Figure 3.2: Condition status of SSSI units within the Ant Broads and Marshes SSSI (Natural England 27 October 2014, accessed by RSPB 12 December 2014 from http://www.magic.gov.uk)

Unit 10 represents the area of consideration on Sutton Fen. Unit 3 covers the BC owned area of Catfield Fen. Key: Dark Green (favourable condition), light green (unfavourable recovering); red (unfavourable declining).

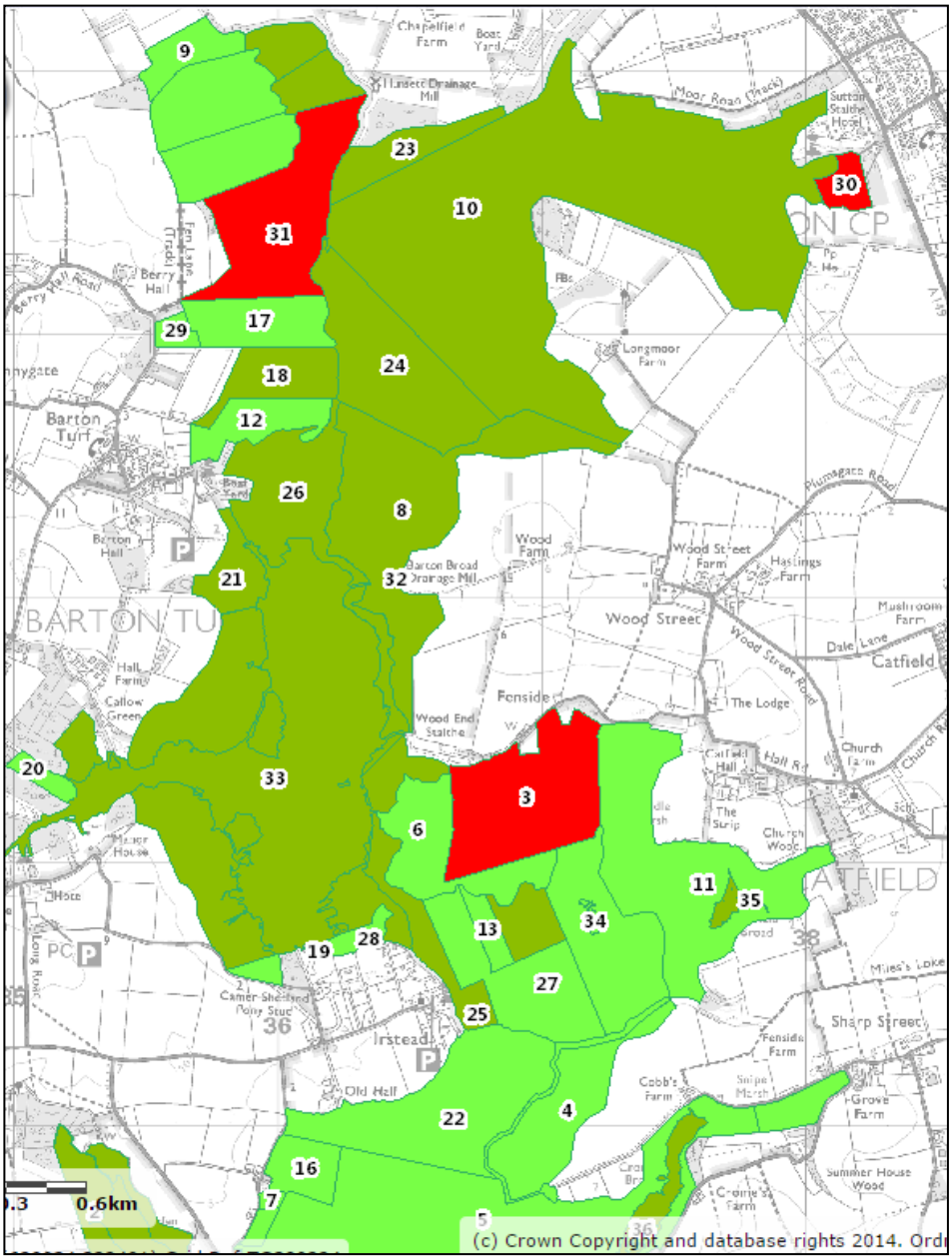


Figure 3.3: Updated condition status of SSSI Units within the Ant Broads and Marshes (land ownership details have been redacted). (Natural England 27 October 2014, accessed by RSPB 15th December 2014 from http://designatedsites.naturalengland.org.uk/SiteUnitList.aspx?SiteCode=S1000501&SiteName=ant%20broads%20and%20marshes&countyCode=&responsiblePerson=). Unit 10 corresponds with the area of consideration on Sutton Fen. SSSI Unit 3 covers the BC owned area of Catfield Fen. Key: Dark Green (favourable condition), light green (unfavourable recovering) and red (unfavourable declining).

ANT BROADS AND MARSHES

Unit	Unit name	Condition	Condition Threat Risk	Habitat	Area (ha)	GridRef	
001	[redacted]	Favourable	No identified Condition Threat	FEN, MARSH AND SWAMP - Lowland	10.41	TG 358 236	View map
002		Favourable	No identified Condition Threat	FEN, MARSH AND SWAMP - Lowland	30.58	TG 366 219	View map
003		Unfavourable - Declining	High	FEN, MARSH AND SWAMP - Lowland	25.25	TG 369 212	View map
004		Favourable	No identified Condition Threat	FEN, MARSH AND SWAMP - Lowland	18.29	TG 372 200	View map
005		Favourable	No identified Condition Threat	FEN, MARSH AND SWAMP - Lowland	121.82	TG 366 193	View map
006		Favourable	No identified Condition Threat	FEN, MARSH AND SWAMP - Lowland	16.65	TG 367 208	View map
007		Favourable	No identified Condition Threat	FEN, MARSH AND SWAMP - Lowland	0.6	TG 359 197	View map
008		Unfavourable - Recovering	No identified Condition Threat	FEN, MARSH AND SWAMP - Lowland	36	TG 365 223	View map
009		Favourable	No identified Condition Threat	FEN, MARSH AND SWAMP - Lowland	5.3	TG 356 240	View map
010		Unfavourable - Recovering	High	FEN, MARSH AND SWAMP - Lowland	123	TG 371 233	View map
011		Favourable	High	FEN, MARSH AND SWAMP - Lowland	35.84	TG 375 209	View map

Table 3.2: Condition history of the Ant Broads and Marshes SSSI Unit 3. Taken from Natural England website 15th December 2014 http://designatedsites.naturalengland.org.uk/UnitDetail.aspx?UnitId=1015926&SiteCode=S1000501&SiteName=ant+broads+and+marshes&countyCode=&responsiblePerson=.

Assessed	Condition	Assessed By	CSM assessment date	Visited By
27/10/2014	Unfavourable - Declining	GARDINER, (ADRIAN)		
16/09/2013	Unfavourable - Recovering	GARDINER, (ADRIAN)	16/09/2013	GARDINER, (ADRIAN)
08/11/2011	Unfavourable - No change	GARDINER, (ADRIAN)	08/11/2011	GARDINER, (ADRIAN)
22/12/2010	Unfavourable - No change	GARDINER, (ADRIAN)	28/01/2010	GARDINER, (ADRIAN)
28/01/2010	Favourable	GARDINER, (ADRIAN)	28/01/2010	
16/06/2004	Favourable	DOARKS, (CLIVE)	16/06/2004	DOARKS, (CLIVE)
26/10/1998	Unfavourable - Recovering	SOUTHWOOD, (RICK)	26/10/1998	SOUTHWOOD, (RICK)

Upper Thurne Broads and Marshes SSSI

3.32 The RSPB understands that impacts on the Upper Thurne Broads and Marshes SSSI are not likely to be significant. However, we have limited knowledge of this SSSI and are unable to comment on this site at this time. We recommend that the Environment Agency and Natural England review this site in the future to ensure that features of the site are not being adversely affected.

Fen orchid

3.33 The Joint Nature Conservation Committee recently reported to the European Commission on the conservation status of the fen orchid in the UK[12]. The overall status of the species is assessed as "*...Bad because range, population, and future prosects [sic] have been assessed as Bad*." The Report highlights that the species is declining at greater than 1% per year based on survey evidence between 2001 and 2012. The long term trend is decreasing. The report highlights that "*human induced changes in hydraulic condition*" and "*Biocenotic evolution; succession*" are the two greatest threats to the species. High priority measures identified to address the problem faced by the species are "*other wetland-related measures*"

[12] JNCC (2013). *European Community Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC): Third Report by the United Kingdom under Article 17 on the implementation of the Directive from January 2007 to December 2012: Conservation status assessment for Species: S1903 - Fen orchid (Liparis loeselii)*. JNCC.

to be implemented "*both inside and outside*" sites where fen orchid occurs, as well as establishing "*protected areas and sites*" and ensuring appropriate "*legal protection of habitats and species*." The report does highlight that existing colonies are protected as Special Areas of Conservation and are therefore subject to stringent protection measures under EU law.

3.34 In order to understand the importance of the fen orchid colonies within the Ant Broads and Marshes SSSI the RSPB has been in contact with the site managers for each known fen orchid location, liaised with Plantlife over fen orchid ecology and carried out our own surveys. Data has been collated and as full a survey as possible of those locations was conducted in 2014 (Table 3.3).

Table 3.3: Collated fen orchid data from all known sites

Ant Valley	**SSSI Unit**	**2013 count**	**2014 count**
Sutton Broad			
Sutton Broad South	10	1326 (partial)	1538 (partial)
Sutton Broad East	10	23 (full)	30 (full)
Catfield Fen			
Catfield Mill Marsh West (BC)	3	964 (partial)	1843 (partial)
Catfield Mill Marsh East (BC)	3	3 (partial)	83 (full)
Catfield Hall Estate	11	1(partial)	0 (full)
Catfield Great Fen	6	Not surveyed	187 (full)
Total		2317	3469
Other UK locations			
Upton Fen (Broads)[2]		12 (full)	38 (full)
Kenfig Dunes (Bridgend, Wales)[3]		45 (full)	40 (partial)
Total		57	
Grand Total		2374	3759

All numbers are number of 'spikes'

[1] The introduced population at Ranworth Broad is not included - the plants are of non-UK origin and are not considered part of the native fen orchid population.

[2] Personal Communication with Tim Pankhurst (Plantlife), figure not verified.

[3] *Liparis loeselii Ovata* (Dune variety) subspecies.

3.35 In 2014, in the UK, fen orchids were found in 4 locations. The number of fen orchid spikes counted was 3759 though most locations were not counted in full. The colony of subspecies *L. l. Ovata* is found in Wales; subspecies *L. l. loeselii* is found at 3 locations in England. Of the 3 English locations, one is in the Bure Broads and Marshes SSSI and 2 are in the Ant Broads and Marshes SSSI.

3.36 The counts of the 2 locations within the Ant Broads and Marshes SSSI found 3681 spikes, 97.9% of the known UK population of fen orchid. Of these, 3494 (93.0%) are on Sutton Broad SSSI Unit 24 (41.7%) or Catfield Fen SSSI Unit 3 (51.2%).

3.37 The baseline fen orchid surveys are detailed in Appendix 3 of the RSPB's response.

3.38 Since the RSPB last reported on fen orchid to the Environment Agency and Natural England Further assessment has been carried out on the SSSI Unit 3 population to better understand the scale of the threat posed by increasing Sphagnum spp. into the fen orchid colony. The observed changes across the site are estimated to threaten over 50% of the UK fen orchid, with 20 plants lost between 2013 and 2014 alone. Maintenance of the Catfield Fen population is therefore critical to securing its long term survival in the UK. Detailed information on the threat to the SSSI unit 3 fen orchid colony is presented in Appendix 3 of the RSPB's response.

Potamogeton coloratus (RDB plant species)

3.39 Parmenter (2014)[13] documents the apparent loss of the alkaline-dependent *Potamogeton coloratus* (fen pondweed)[14] at Catfield Fen, in favour of the acid-dependent *Potamogeton polygonifolius* (bog pondweed)[15]. The RSPB supports the findings and conclusions of this survey. Since Parmenter's survey in early 2014, the RSPB has carried out further surveys at Catfield Fen Unit 3 using identification advice from Parmenter to look for *P. coloratus* in all likely locations. Approximately 12 hours have been spent looking for *P.coloratus* by RSPB staff on Unit 3; however no plants have been found. It is now considered likely that the species is absent from Unit 3. *Potamogeton polygonifolius* was encountered beyond the area investigated by Parmenter, including small colonies in Meadow Marsh and Turf Pond Marsh and is more widespread within Sluice marsh than noted following Parmenter's short survey.

3.40 *Potamogeton coloratus* is known to be present on Sutton Fen in the Decoy Fen area on Unit 24 with identification confirmed by Parmenter in August 2014. *Potamogeton polygonifolius* is not known to occur on Sutton Fen Units 8, 10 or 24, but could have been overlooked.

3.41 These two species are notoriously difficult to identify and it is now considered that this species was misidentified in the Broads Authority fen audit in 2007, the RSPB quadrat survey in 2012 and the Natural England condition assessment in 2013.

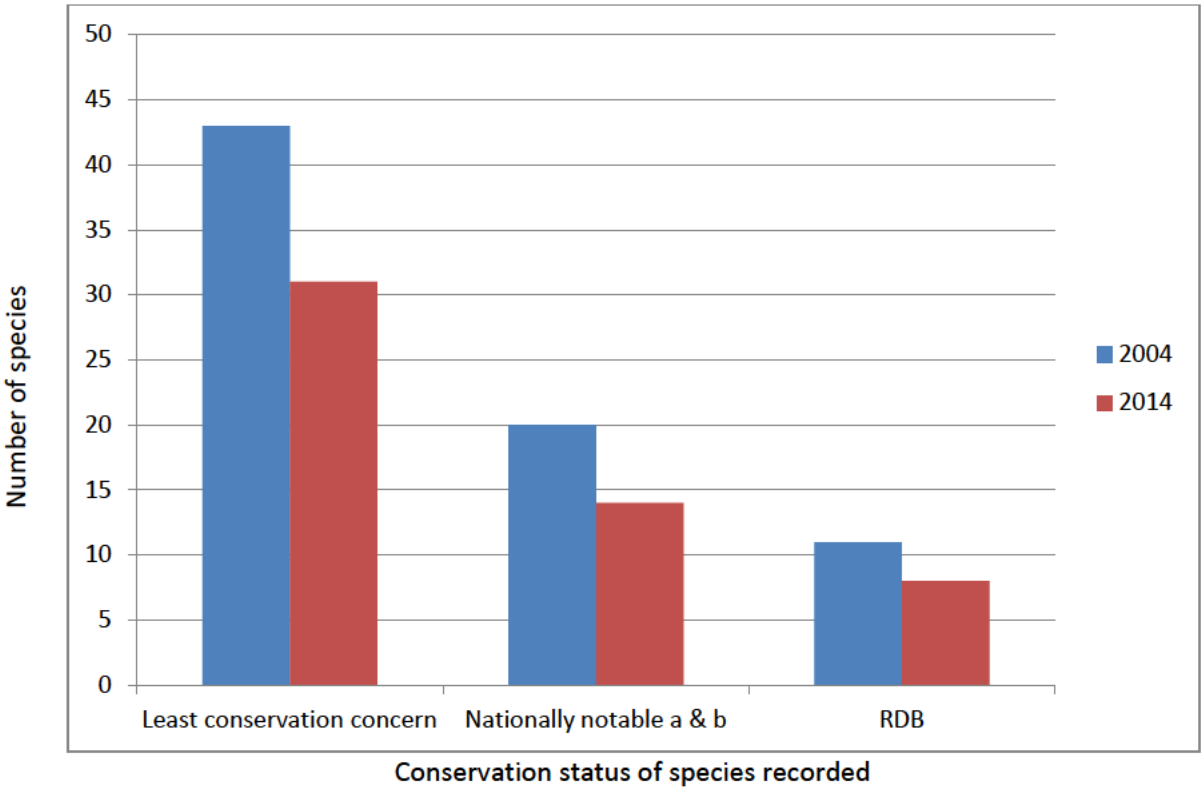
Water beetles

3.42 In 2003 and 2004, baseline surveys of the invertebrate interest on SSSI Unit 3 were undertaken. This highlighted that the site was nationally important for a number of rare and threatened species that form part of the Red Data Book list. One group, water beetles, were represented by 22 RDB species (18 species recorded during the 2003 and 2004 surveys and four additional species recorded in 1904, 2000 and 2001) making SSSI Unit 3 the most

[13] Parmenter, J. (2014). *Condition Assessment at Catfield: consideration of recent trends in Potamogeton and Liparis in Unit 3*. The Landscape Partnership.
[14] See http://www.brc.ac.uk/plantatlas/index.php?q=node/2559 for review of *P. coloratus*.
[15] See http://www.brc.ac.uk/plantatlas/index.php?q=node/1173 for review of *P.polygonifolius*.

important site for aquatic coleoptera in the UK. A significant change to the habitat within SSSI Unit 3 has occurred since the baseline water beetle survey, consequently a re-survey was commissioned in 2014.

Figure 3.4: Proportion of species under different conservation status recorded in 2004 and 2014 surveys. The first column highlights the number of species recorded in one year only. Conservation status based on Foster 2010.



3.43 The 2004 surveys recorded a total of 75 species over the two-day survey period. Of these, 11 species had RDB status and 20 species were nationally notable (Figure 3.4). The 2014 survey recorded a total of 56 species. Of these, 8 species had RDB status and 14 species were identified as nationally notable (Figure 3.4).

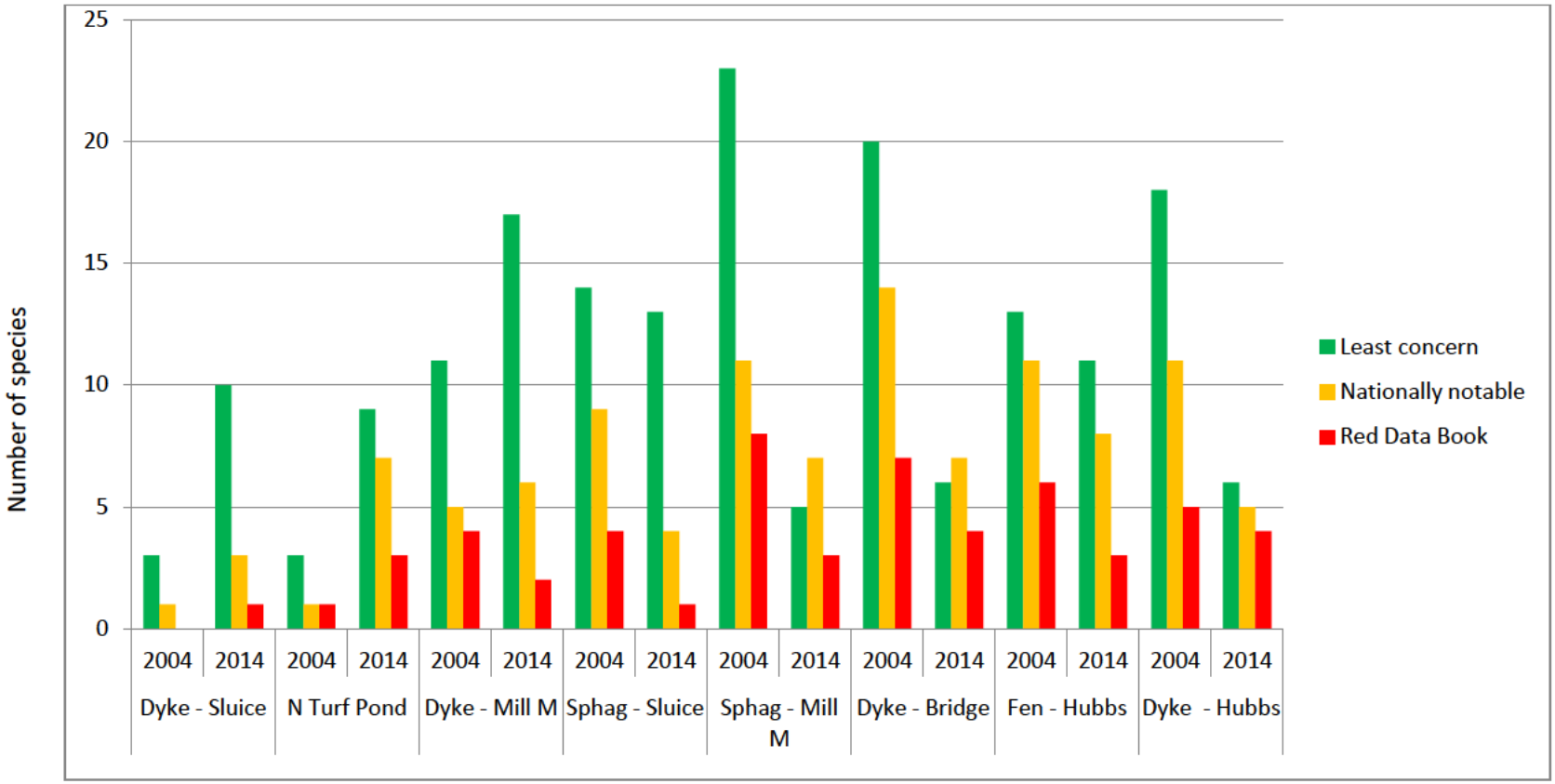
3.44 The 2014 survey recorded significant variation in the water beetle community since the 2004 survey. Overall, a *c.*27% decline in the number of species recorded. In 2014, there were *c.*27% fewer RDB species recorded, *c.*30% fewer Nationally notable species, and even common and widespread species had declined by *c.*28%. Whilst 24 species were not relocated in the 2014 survey, there were nine new species added to the site list. Of these, one species, *Peltodytes caesus*, is Nationally notable.

3.45 The full survey report is provided in Appendix 5 of the RSPB's response, with a table of the full list of species recorded on SSSI Unit 3 and their respective presence in 2004 and 2014 surveys is provided in Appendix 6 of the RSPB's response.

3.46 Whilst surveys of invertebrate fauna have been conducted in recent years[16],[17] the RSPB is not aware of any surveys that can replicate surveys for a single species group on Catfield Fen SSSI Unit 3 to examine trends in a single species population. Although only two surveys have been undertaken, the surveys cover the same sample points and have been undertaken some ten years apart. They do indicate significant changes in the aquatic coleoptera assemblage. These changes have affected rare, national scarce and even widespread species. It is particularly notable that even widespread species have declined, as they indicate wider changes taking place on the site that are causing fundamental changes to the species group as a whole.

[16] Lott, D.A, Drake, C.M., & Lee, P. (2010). *Broads fen Invertebrate Survey*. Arachne Invertebrate Information Services.
[17] Lee, P., Drake, C.M., & Nobes, G. (2012). *Broads Fen Invertebrate Survey*. Arachne Invertebrate Information Services.

Figure 3.5: Comparison of the number of species differing conservation status recorded at each sampling point in both 2004 and 2014. Conservation status based on Foster 2010.



Other Red Data Book invertebrate species

3.47 The SSSI citation recognises the importance of the Ant Broads and Marshes for a range of invertebrate species. Those identified in the citation include:

- *Papilio machaon brittanicus* swallowtail butterfly
- *Trogus lapidator* – a wasp parasite of *Papilio machaon*
- *Pelosia obtusa* small dotted footman – one of 45 rare or notable species of moth
- *Ceutorhynchus querceti* – a weevil
- A large number of rare or notable *Diptera* (trueflies).

3.48 All of these species are known within at least one of Units 3, 8, 10 and 24.

3.49 Swallowtail butterfly breeds in large number on all Units listed above with Sutton Fen recording the highest numbers of any UK site from 2011 to 2014. As a smaller site, Unit 3 has a smaller population, nevertheless it is regarded as one of the most important sites for Swallowtail in the UK.

3.50 The only recent UK records of *Trogus lapidator* are from Catfield Fen (Nobes, 2007); it is possible that this species is now only found in the Catfield Fen area.

3.51 *Pelosia obtusa* is one of 5 RDB moth species whose UK population stronghold is within the SSSI. Nine *Pelosia obtusa* adults were trapped on Unit 3 in 2014 and good numbers are trapped annually on units 10 and 24.

3.52 *Ceutorhynchus querceti* was recorded on unit 10 in 2007, it is not known from Unit 3, but weevils have not been studied on this site.

3.53 Catfield and Sutton Fen support an exceptional *Diptera* assemblage with a large number of rare and notable species including *Dolichopus laticola* and *Dolichopus nigripes*.

3.54 During the water beetle surveys conducted in 2004 and 2014, *Hydrometra gracilenta* lesser water measurer was recorded. This is a UK priority species listed on Section 41 of the NERC ACT 2006, a 2007 BAP species and a long standing RDB species.

3.55 Despite impressive species lists (provided in Appendix 7 of the RSPB's response), Catfield Fen and Sutton Fen have been relatively poorly recorded historically with large gaps in recording effort. RSPB and BC have and are encouraging additional survey work as demonstrated by the repeat aquatic coleoptera surveys in 2014.

4. Site and water management undertaken at Catfield Fen and Sutton Fen

Introduction to Site Management chapter

4.1 Throughout the history of the Catfield abstraction case, there has been significant mention of the management undertaken on site to maintain site condition. Reports and comments to date have implied, erroneously, that management has ceased to take place on the site and that lack of management is a primary cause for site deterioration. It has been suggested that the failure to manage the site effectively is allowing succession to take place resulting in terrestrialisation of the site. These conclusions have been made by parties who have not consulted with the site managers of either Unit 3 or 11 and many of whom have not accessed the site, except from observations made from the boundaries.

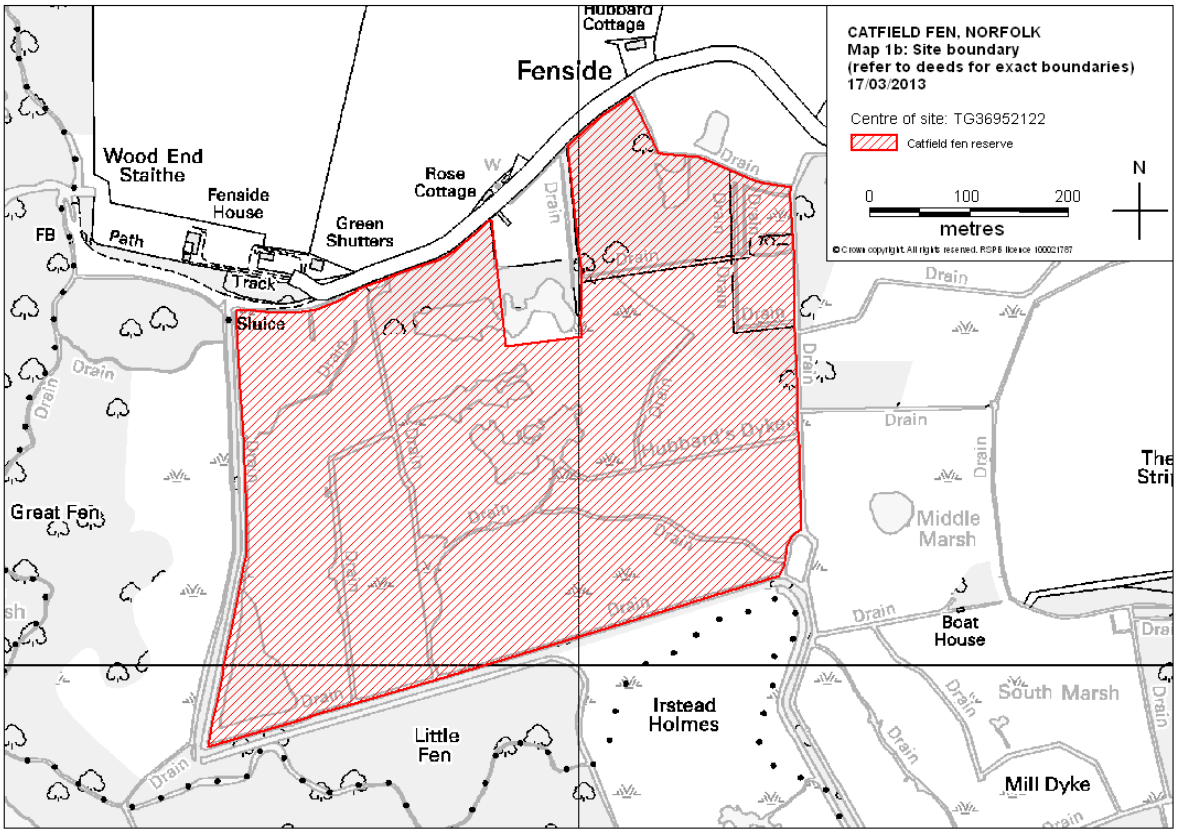
4.2 Natural succession and terrestrialisation occurs at all fen sites. Management intervention aims to slow this change, or, using drastic measures, reset the system back to its early successional stage. This extreme intervention always needs to be assessed to ensure that it is appropriate given the wider designations of a site. Smaller interventions that have such an effect more locally within the site may be more appropriate. However, such measures will only be successful if the underlying conditions of a site have not been degraded. In this instance, efforts to restore a site may be unsuccessful, as the quality of the habitat that redevelops may not support the conditions or features that the management was intended to restore. In wetland systems, an altered hydrological regime would make any management interventions less successful.

4.3 In the case of Catfield Fen Unit 3, management has been undertaken on the site and documented. Measures to arrest the deterioration (such as turf ponding) have failed, indicating that other factors are affecting the underlying conditions of the site. Substantial changes to the hydrological regime of the site are likely to be a major cause for this situation.

4.4 Having reviewed the available information, the RSPB is able to identify management plans and actions for SSSI Unit 3 dating back to 1993, the first full year of Butterfly Conservation ownership. The RSPB is not able to comment on habitat management carried out on the wider Catfield Fen area, including Catfield Hall estate, Catfield Great Fen or Catfield Little Fen. However, a detailed account of management on SSSI Unit 11 has been detailed in Parmenter & Riches (2014)[18]. The following information provides a history of Butterfly Conservation and RSPB involvement with the site and details the management that has been undertaken and the outcomes of specific management interventions in the past few years.

[18] Parmenter, J., & Riches, P. (2014). *CATFIELD FEN: A Response to the AMEC Technical Note: Notes on the Management of Catfield Fen*. Catfield Hall Estate.

Figure 4.1: Map showing boundary of Butterfly Conservation owned area of Catfield Fen.



History of management at Catfield Fen

4.5 Butterfly Conservation purchased SSSI Unit 3 (Figure 4.1) from the McDougall family in 1992. Following the acquisition, Butterfly Conservation has worked closely with Natural England (and their predecessor, English Nature) to ensure that management undertaken on the site has been, and is, appropriate to the sensitive habitats and species that the site supports. The aim of management has always been to ensure favourable condition status is maintained or restored.

4.6 In 2011, an informal arrangement was reached between Butterfly Conservation and the RSPB to work together to manage SSSI Unit 3. In 2013, management was formally transferred to RSPB for a 10-year period. This enabled Butterfly Conservation to share resources being used to manage the RSPB's Sutton Fen reserve.

4.7 As highlighted in section 3 of the RSPB's response and documented in the draft determination report, Catfield Fen is highly protected for the habitats and wildlife supported on the site (SSSI, SAC, SPA and Ramsar). In order to ensure that such sites are effectively managed, money has been provided under various stewardship schemes to support measures to maintain and/or restore the site to favourable condition. The schemes involved are:

- Catfield Fen Reserves Enhancement Scheme 1995 – 2003
- Catfield Fen Environmentally Sensitive Area 2003 – 2013

- Higher Level Stewardship agreement 2013 - 2023

4.8 In addition to money from stewardship schemes, Butterfly Conservation has invested additional money into managing SSSI Unit 3. The owners of the site have regularly spent in excess of the income received to restore and maintain the site in favourable condition.

4.9 All core and grant funds have largely been put towards managing scrub encroachment on the site and the restoration of open fen habitat. Additional measures such as commercial reed and sedge cutting and the creation of scrapes and ponds have also been undertaken in order to retain areas of open water and ensure that the presence of early stage habitats are maintained. All management has been monitored by English Nature and Natural England, and has been fully documented through various management plans since 1993, which set out the priorities, objectives and targets. All plans were approved and signed off by Natural England (or English Nature).

4.10 The management plans have been, and continue to be, reviewed annually through management meetings. These meetings include a range of interested parties in order to ensure that appropriate expertise is available to advise on management measures for the coming year that will underpin efforts to restore the site to favourable condition. This usually includes the Butterfly Conservation volunteers responsible for day-to-day management of the site until 2013, the reed and sedge cutter and a representative from Natural England. Occasionally other attendees such as the chair of the Broads Reed and Sedge Cutters Association, Butterfly Conservation staff and RSPB ecologists attend. From 2012, RSPB has coordinated these management meetings.

4.11 In order to deliver the management plans, contractors are employed and volunteers are used to help with site management activities. Whilst there have been no dedicated staff working at Catfield Fen since 1992, a conservative effort of staff time input by Butterfly Conservation and latterly, RSPB staff toward habitat management at Catfield Fen is 20 man days per year totalling 460 man days since 1992. Volunteers have been a key work force on the site. Information gathered by Butterfly Conservation and RSPB since 1996 has recorded a total of 133 volunteer work parties totalling over 1300 ‘person-days’ of volunteer effort.

Habitat management undertaken at Catfield Fen SSSI Unit 3 from 1992 to present

4.12 The RSPB has reviewed the available information regarding habitat management of SSSI Unit 3. This is based on records held by Butterfly Conservation and the information contained within management plans. A summary of management during each plan period is included (Table 4.1, Figure 4.2). There are gaps in the data and these have been filled with estimates based on recollection of BC volunteers responsible for managing the site, supplemented by aerial photographs, invoices and recollections of the reed and sedge cutter. This anecdotal evidence is shown in italics for clarity; records pre-1996 are very patchy and have not been included. A detailed account of each management plan period is set out below.

Table 4.1: Average amount of annual management undertaken at Catfield Fen SSSI Unit 3 during each management plan period

Plan Period	Commercial sedge (ha)	Commercial reed (ha)	Patchy scrub 'rogueing' (ha)	Scrub removal (ha)	Non commercial fen cutting (ha)	Dyke clearance (km)	Bank veg cutting (km)
1993 – 1997*	3.0	0.2	1.8	0	1.2	0	1
1997 - 2003	6.45	8.0	3.32	0	0	0.4	3
2003 - 08	5.5	3.0	1.3	0	4	0.5	5
2008 – 13**	3.0	3.65	1.8	2.4	1.63	0.8	5.5
2013 – 18***	3.8	0****	1.0	2.8	5.2	2.3	6.9

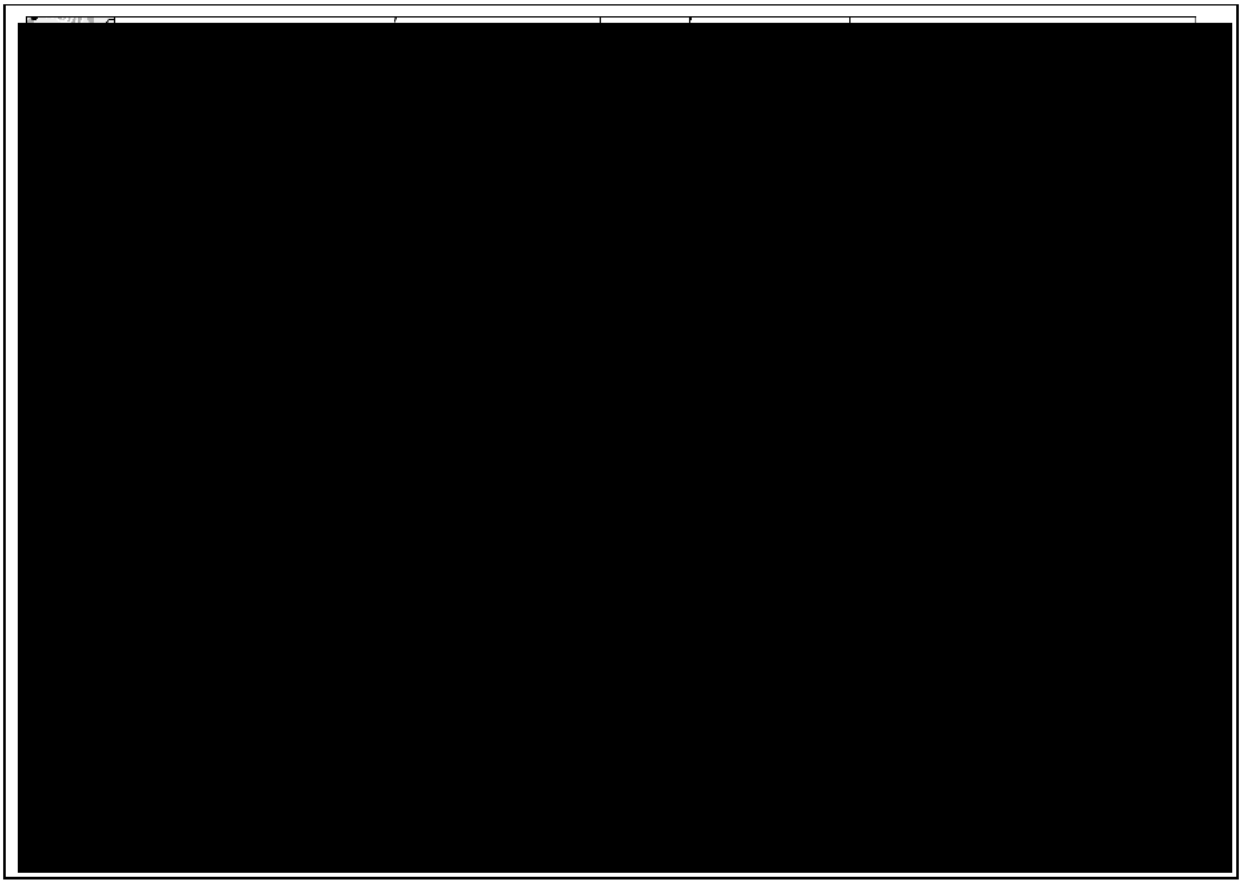
*The amount of each management type is based on 1996/7 documented records supplemented by estimates based on aerial photographs and recollection of the site sedge cutter.

**NB only five years between plans rather than the previous six years.

*** This is within the current management plan period, includes cutting planned within HLS agreement and management plan.

**** The commercial reedbed declined due to drying and acidification and was replaced with non commercial winter mowing in 2011

Figure 4.2: Map showing the compartments on Butterfly Conservation owned Catfield Fen.



4.13 There has been a continued history of intensive habitat management at Catfield Fen since 1992. The amount of cutting management of Catfield Fen has been comparable, or in excess of, the work carried out on a typical Broadland fen as shown in Table 4.2. Management of Catfield Fen has been fairly typical of a Broadland fen managed either by a conservation organisation, a statutory body or funded through a Higher Level Stewardship scheme. Management of Catfield Fen is similar to management of other Nature Reserves in the Broads such as Sutton Fen (RSPB), Strumpshaw Fen (RSPB), How Hill (Broads Authority), Catfield Great Fen (Norfolk Wildlife Trust) and Woodbastwick (Natural England). The typical range of management measures are applied to the site, including commercial and non-commercial cutting, ditch maintenance, bank mowing and scrub rogueing. In addition, Catfield Fen has had a higher level of turf pond digging than the majority of Broadland sites over recent years. This level of management is due to continue under the current management plan and will be reviewed annually in order to ensure management continues to be appropriate to meet the objectives set out in the current and future management plans.

Table 4.2. Levels of cutting management in the Broads

	Catfield Fen		Sutton Fen		Ant Valley		Broads	
Data source	**RSPB records**		**RSPB records**		**Broads Audit 2004**		**Broads Audit 2004**	
	Area (ha)	**%age**	**Area (ha)**	**%age**	**Area (ha)**	**%age**	**Area (ha)**	**%age**
Open Fen	18.5		96.70		380		1650	
Commercial sedge bed*	1.5	8.10	7.00	7.23	20.9	5.50	84.6	5.10
Commercial reed bed	0	0.00	2.30	2.38	12.6	3.30	96.7	5.90
Non commercial cut	5.2	28.10	26.00	26.89	Unknown	23***	Unknown	23***
Open water creation**	0.7	3.80	1.00	1.03	Unknown	Unknown	Unknown	Unknown
Total cutting	7.4	40.00	35.30	36.50		31.80		33.20

* Within current rotation
** Dug within last 10 years
*** % of Broads fen in HQ11 HLS cutting supplement

4.14 Management of the site has been planned around the advice provided by Natural England (and its predecessors, English Nature and the Nature Conservancy Council) and independent ecological advisors. This has ensured the site has been managed sensitively, with the conservation of the site's designated habitats and species setting the management objectives. There has been a continuation of commercial reed and sedge where possible. The loss of areas of commercial reed has been due to drying and acidification of the reedbed. Where commercial cropping has been lost, it has been replaced with similar non-commercial management.

4.15 Of key relevance is the management around the fen orchid colony on SSSI Unit 3. The area where the fen orchid colony occurs has been consistently within commercial or non-commercial cutting rotations since at least 1996. Despite this, the area continues to become more acidic and *Sphagnum* moss continues to grow and increase around the fen orchid colony[19,20]. At no time since 1996 has this area fallen out of regular cutting management. It appears therefore that whilst management is known to slow successional processes, in this case it has not prevented the changes. In 2011 a new turf pond was dug adjacent to the fen

[19] RSPB (2014). *A survey of Sphagnum moss at BC Catfield Fen – redacted*. RSPB
[20] RSPB (2014). *An assessment of Sphagnum Liparis on BC Catfield Fen – redacted*. RSPB

orchid colony with the hope of recreating habitat suitable for the long term colonisation by S24e and Fen orchid. However, the early signs of the ecology are not promising.

4.16 Given that the management outlined is comparable with other managed fens within the Broads it would be expected that similar rates of change would be seen elsewhere if a lack of appropriate management was causing the changes at Catfield Fen. Despite many well monitored sites, we are unaware of any other sites in the Broads undergoing such rapid succession.

Water management undertaken at Catfield Fen SSSI Unit 3 between 1992 to present

Historic water management

4.17 There is a considerable amount of information within various reports[21,22,23] about historic management of the sluices joining the Catfield Fen internal and external systems (Figure 3.2 of the draft determination report). However, an accurate assessment of sluice operation is not considered possible due to the poor quality of documented records for sluice operation prior to 1992 (and to a lesser degree, since 1992). The majority of comment is based on anecdote and distant memory. BC and RSPB have a limited number of documented records of sluice operation.

4.18 It is our understanding that since 1978, the northern sluice has only been operated to let water drain from the internal system to the external system. This has been done sporadically to facilitate commercial reed and sedge cutting on the Butterfly Conservation land when water levels have made either practice impossible. Since 2002, concern has been raised by Natural England and the Catfield Hall Estate on this practice due to the risk of damaging the fen habitats through loss of water. Maintenance of appropriate water levels is challenging throughout the year and ensuring good water levels during the growing season are considered important to maintain the designated vegetation communities of the site and, thus, favourable conservation status. Consequently, the sluice has not been operated since 2007.

[21] Alston A. (2014). *Catfield fen – redacted*.

[22] Parmenter, J., & Riches, P. (2014). *CATFIELD FEN: A Response to the AMEC Technical Note: Notes on the Management of Catfield Fen*. Catfield Hall Estate.

[23] Amec (2014). *Report on the Assessment of Abstraction within the Ludham-Catfield Area in the Vicinity of Ant Broads and Marshes SSSI*. Amec.

4.19 Until early 2014, when it broke following a surge tide and was replaced with a solid board, there was a flap on one of the lower boards in the northern sluice[24]. However, this flap was not set to open when levels were higher on the external than the internal as described in that report, but was set shut so that water could not pass in either direction through the flap. This is described in the Catfield Fen 2003 – 2008 management plan:

"*The northern sluice (sluice A) has a valve, which can be set to allow one-way movement of water in either direction…This system should not be introduced until further agreed monitoring and water typing has been carried out, due to uncertainties over the effects of allowing more base-rich water into the Internal System, but should be considered when more information is available*".

4.20 This monitoring work highlighted in the management plan to determine the ability to operate the sluice was never done. Consequently, ongoing concerns about allowing the more nutrient-rich, external water into the internal system meant that the flap was never used. Many years before the sluice was broken, the flap had seized shut and acted like a solid board. However, during surge events, external water does regularly penetrate over the 'southern bund', over the northern sluice and through the northern sluice by physically forcing the boards apart due to high hydrostatic pressure. We are not familiar with the southern sluice and do not know if this also overtops or leaks during high hydrostatic pressure as well.

4.21 The northern sluice has not been operated to allow water into the internal system since at least 1978 though external water can access the internal system as described above. The northern sluice has not been operated to allow water out of the internal system since 2007, though internal water can access the external system over the southern bund. Some movement also occurs through the rond itself, although volumes are unknown.

4.22 Operation of the northern sluice in the summer of 2007 was to lower water levels to facilitate sedge cutting. This was authorised by Natural England. In exceptionally wet summers, Butterfly Conservation and RSPB reserve the right to apply to Natural England for permission to open the northern sluice to allow summer sedge cutting.

4.23 It is unlikely that Natural England will grant permission for opening the sluice to allow lowering of internal water levels whilst concerns about water levels remain. Despite the potential negative impact on the commercial sedge cutting operation, this seems prudent. Butterfly Conservation and RSPB have encouraged the sedge cutter to find alternative sources for early sedge cutting so that he is able to work at Catfield later in the summer in the future when water levels are always low enough to allow sedge cutting.

[24] Alston A. (2014). *Catfield fen – redacted*.

4.24 Currently, the sluices are left closed year round. However this has not caused any stagnation at Catfield Fen, as implied by both Amec 2014e[25] and 2014f[26] and Alston 2014b[27]. There are many references in the main groundwater report relating to movement of water within the internal system (from precipitation moving from fen compartments to ditches, from crag groundwater moving from aquifer to peat and from dykes toward the East to dykes toward the West for example). Graph 6.17d in the main groundwater report shows regular movement of water on and off Sluice Marsh and, when above the fen surface, water is free to flow on and off all fen compartments. Wind action creates significant water flow along the ditches, as does travel by boat. Therefore, despite there being no regular connection with the external system, water movements are good and assertions that Catfield Fen is stagnant are not supported by any evidence. It is noted that concerns about stagnation on Catfield Great Fen (external system) have been raised in the recent past, leading to excavation of the dyke adjacent the rond. Whilst the RSPB supported this project as it is likely to improve the quality of the commercial sedge crop, there is a lack of evidence to support the observation of stagnation and indeed the plant communities on Catfield Great fen are indicative of high Oxygen content and are some of the best in all of Broadland (BA 2010), possibly due to seepage of groundwater to the North.

4.25 There has been some suggestion that the introduction of foot drains would improve water circulation[28]. In general, access for water onto and off fen compartments is adequate and similar to the majority of fen sites in the Broads. With the exception of 'Island Marsh' all compartments have connection with ditches along at least 50% of their edges. Amec (2014e)[29] consider the main pathway of water to be from fen to ditch. This suggests that if foot drains were dug into the fen compartments these would act to drain the compartment for much of the year. This is reflected by Island Marsh, which only has poor connection to the ditch network yet is one of the wettest areas of Catfield Fen and holds water for longest into the summer (A. Hewitt, *Pers. Comm*.). Therefore, increased connection with the ditches increases risk of further drying that would be detrimental to the designated vegetation communities and species of the site, as highlighted by NE's concerns regarding the operation of the sluice to lower water levels.

4.26 It is important to note that for the majority of the winter, water level is higher in the internal system than the external[30]. The RSPB has also gathered evidence that demonstrates pH is also usually higher in the internal dykes despite the lack of open connection to the river (Appendix 9). Therefore it is unclear whether increasing connection with the external system would help to either raise levels within the internal system or increase base richness. Increased connection during the winter months may therefore be detrimental by increasing drainage of the internal system and diluting the high pH water in the dykes.

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[25] Amec (2014). *Site management technical note*. Amec.

[26] Amec (2014). *Report on the Assessment of Abstraction within the Ludham-Catfield Area in the Vicinity of Ant Broads and Marshes SSSI*. Amec.

[27] Alston A. (2014). *Catfield fen – redacted*.

[28] Alston A. (2014). *Catfield fen – redacted*.

[29] Amec (2014). *Site management technical note*. Amec.

[30] Amec (2014). *Report on the Assessment of Abstraction within the Ludham-Catfield Area in the Vicinity of Ant Broads and Marshes SSSI*. Amec.

Water quality data

4.27 In the absence of any other available data on the relative water quality (Total Nitrogen, Total Phosphate, Conductivity and pH are considered the most important factors) of the internal and the external systems, the RSPB started sampling dyke water on either side of the rond in 2012. The data is presented below in Figure 4.3 and Table 4.3.

4.28 This is a short run of data and many sample points were new in 2014 and only have one data point therefore conclusions should not be drawn, but the data can act to guide further monitoring and to tentatively identify areas of concern.

4.29 In relation to sluice management, the most important samples are those adjacent the rond as these would be the most connected dykes, for that reason, this discussion uses the average figures for the 'rond dykes' as described in Table 4.3.

Figure 4.3: Location of RSPB water quality sampling points on Catfield Fen

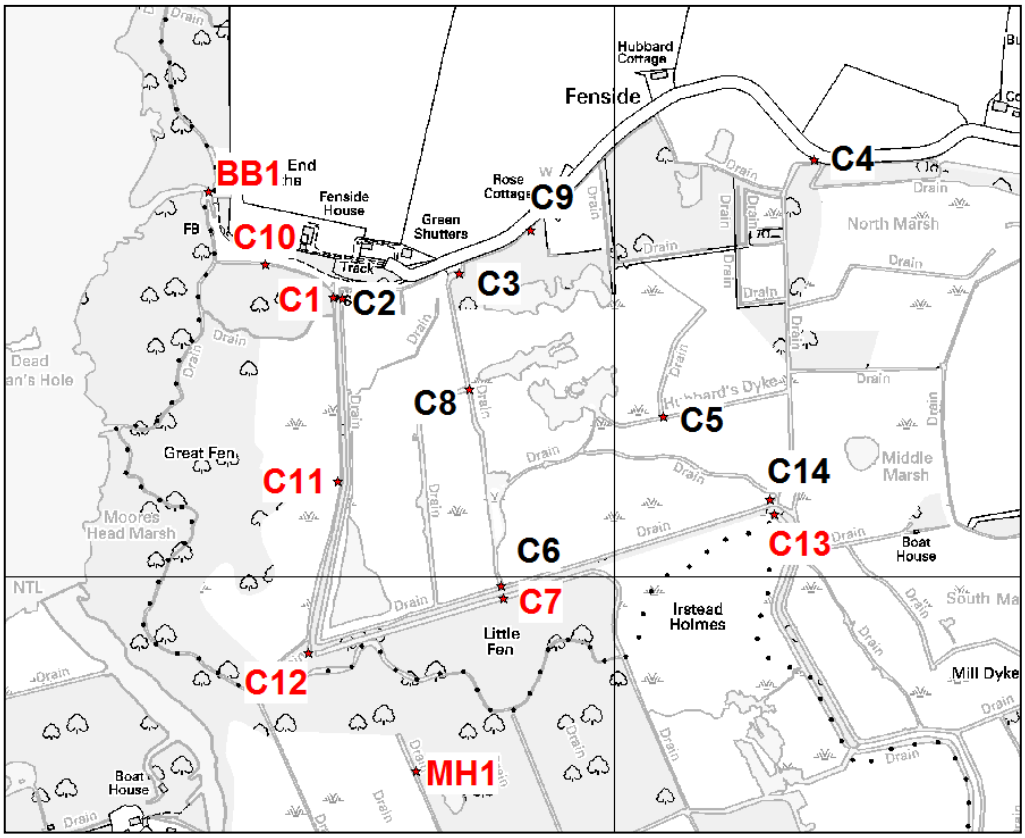

Table 4.3: RSPB water quality data for Catfield Fen

Code	Description	No. of samples 2012 - 2014	pH	Total Nitrate (mg/l)	Total Phosphate (mg/l)	Conductivity (us/cm)
C1	External fen dyke - sluice	5	7.23	0.26	0.05	622.00
C2	Internal fen dyke - sluice	5	7.27	0.24	0.13	539.00
C3	Internal catchwater dyke	5	7.26	0.22	0.09	582.00
C4	Internal catchwater dyke	5	7.15	0.83	0.58	631.00
C5	Internal fen dyke	5	7.26	0.20	0.05	545.00
C6	Internal rond dyke	5	7.34	0.37	0.05	618.00
C7	External rond dyke	3	7.14	0.20	0.07	767.00
C8	Internal fen dyke	1	7.45	0.21	0.05	588.00
C9	Internal catchwater dyke	1	7.27	0.35	0.43	574.00
C10	Choked dyke off broad	1	7.40	0.32	0.09	812.00
C11	External rond dyke	1	6.99	0.20	0.02	699.00
C12	External rond dyke	1	7.10	0.20	0.04	744.00
C13	External rond dyke	1	7.25	0.20	0.04	845.00
C14	Internal rond dyke	1	7.38	0.20	0.15	630.00
BB1	Barton Broad	2	7.54	0.34	0.34	962.00
MH1	Dyke off river	1	7.63	0.47	0.47	849.00
Average for all		43	7.27	0.35	0.13	687.94
Average for internal		28	7.28	0.33	0.15	588.00
Average for external		15	7.25	0.50	0.10	788.00
Average River / Broad		3	7.57	0.35	0.35	906.00
Average for internal rond dykes		11	7.31	0.30	0.09	596.00
Average for external rond dykes		11	7.19	0.48	0.06	736.00

Data was collected by sampling dyke water surface using clean bottles.
Samples are sent by next day courier to National Laboratory Service for immediate storage and testing.
The maximum period between collection and testing is 48 hours.

4.30 From the limited data set, the following observations are made;

- pH was higher on the internal than external (7.31 and 7.19)
- Nitrate was higher on the external than internal (0.48 and 0.30)
- Phosphate was higher on the internal than external (0.09 and 0.06)
- Conductivity was higher on the external than internal (736 and 596)
- The samples nearest the river (MH1 and BB1) are considerably 'poorer' than those away from the river
- The samples near the upland arable (C4, C3, C9) are considerably 'poorer' than those away from the upland arable.

4.31 To build conclusions, additional monitoring is required. Initial concerns raised are the High Nitrate and Conductivity in the external system.

4.32 The high nitrate figure came largely from one 'spike' in February 2012 of 2.79 at C1. These spikes have been picked up in the River Ant (RSPB water quality sampling) following heavy rain causing overflows at Stalham sewage works and from the sewage system in the village of Sutton. It would be ecologically undesirable to allow water with high nitrate content into the internal system.

4.33 The conductivity readings are fairly consistent between sample sets and are known to be caused by surge tides forcing saline water up river from the North Sea. It would be ecologically undesirable to allow water with high Conductivity into the internal system.

4.34 The higher phosphate figure in the internal system is certainly caused by input of arable runoff water into the dykes. The Environment Agency and Natural England are aware of the issue of surface water runoff into both Sutton Fen and Catfield Fen. Measures to prevent ongoing pollution input to the SSSI have not been implemented. At Catfield Fen, It would be ecologically desirable to allow high phosphate water to exit the internal system, though it is possible that the associated drop in water levels would be damaging. It would therefore be preferably to tackle the phosphate input at source.

4.35 The pH value in the above table is of interest. Conclusions cannot be made from such a short run of data, but it is surprising that the ditch water within the internal system appears to be more alkaline than the external, despite a much higher pH in the river. This could be indicative of the known crag groundwater input into the dykes to the east of Catfield Fen or further unconfirmed inputs into Unit 11 and 3 and could demonstrate their importance not only in the locality of the connection with the crag but throughout the internal dyke network.

4.36 The RSPB consider that a precautionary approach is required and that allowing any increased connectivity between the external system and the internal system could be detrimental to the integrity of the ditch and open fen communities at Catfield Fen. Comments in Alston 2014b[31] that increased nutrient would benefit reed growth are inappropriate in the context of the conservation of important plant communities for which

[31] Alston A. (2014). *Catfield fen – redacted*.

the site has been designated; increased nutrient levels are widely understood to be detrimental to wetland ecology[32,33,34,35,36].

Analysis of water level data from SSSI Unit 3

4.37 In November 2013, RSPB submitted a document to the Environment Agency identifying a decreasing water level trend within the internal system at Catfield Fen (RSPB 2013b)[37], by analysing data supplied by the Environment Agency. The Environment Agency responded to the RSPB report to clarify that there were errors in the data due to datum shifts and other inconsistencies (Environment Agency 2013c). The latest data sets for G1 and G2 as stored on EA's WISKI were sent to RSPB in November 2014. These data sets included datum corrections and provided "*the most complete and correct record of the two gauge-boards*" (EA pers. Comm.). However, due to substantial changes in datum over this period (by around 20cm) water level data from both gauge-boards are unreliable and no conclusions can be drawn from their comparison or analysis of their trends.

4.38 There appear to be similar constraints on all other dyke and peat water level datasets within the internal system and therefore there is no available data to identify water level trends within the internal system at Catfield Fen and any statements implying that there is or is not a drying trend at Catfield fen are erroneous due to a lack of data.

4.39 Currently, therefore, the RSPB considers that due to a lack of accurate water level data, there can be no analysis of long term water level trends within the internal system at Catfield Fen. This does not mean that there has or has not been a change, only that the data is not good enough to identify any change should it have occurred. Therefore, a precautionary approach should be applied that there could have been a reduction in water levels from 1986 to 2014, especially given the weight of secondary and anecdotal evidence implying the site is currently too dry to maintain its SSSI and SAC features in the longer term, as demonstrated by the latest Natural England condition assessment (Unfavourable declining with hydrological threats) and documented changes indicative of unsuitable hydrology.

4.40 It should be noted that the problems with these gauge boards have been noted from at least 2003 and have been entirely the Environment Agency's responsibility to rectify. An accurate data set from 2003 to 2014 may have been adequate to identify trends (or lack of trends) in water levels.

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[32] http://www.snh.gov.uk/docs/B823176.pdf

[33] http://n-steps.tetratech-ffx.com/PDF&otherFiles/literature_review/Eutrophication%20effects%20on%20wetlands.pdf

[34] http://ec.europa.eu/environment/nature/natura2000/management/habitats/pdf/7230_Alkaline_fens.pdf

[35] http://www.ipcc.ie/a-to-z-peatlands/peatland-action-plan/nutrient-pollution-of-peatlands/

[36] http://www.planta.cn/forum/files_planta/nutrient_limitation_and_nutrient_driven_shifts_in_plant_species_composition_in_a_species_rich_fen_meadow__847.pdf

[37] Sutton and Catfield Summary (letter from RSPB to Environment Agency dated 6 December 2013)

Lack of historic water level data

4.41 In addition to the lack of useable data, all water level analysis in (the main groundwater report) focuses on relatively recent data (post 1986). Given that the abstraction license renewals need to determine if there is a likely significant affect from abstraction in comparison with naturalised (i.e. no abstraction) conditions, data on water levels before abstraction commenced in 1986 is required. Failing availability of this data, long term 'no pump' tests should have been carried out to identify impact of no abstraction on water levels. The pump test data available is inadequate and should not be used to assess impact of abstraction on water levels.

4.42 Currently, therefore, the RSPB considers that to form a baseline upon which to assess the impact of abstraction, a long running and accurate record of water levels prior to abstraction is required (or gained from 'in-combination', long running pump tests). In the absence of this, it is not possible to correctly model the natural water balance of Catfield Fen or to model the impact of abstraction. Therefore, a precautionary approach should be applied that there could have been a reduction in water levels due to water abstraction, especially given the weight of secondary and anecdotal evidence implying the site is currently too dry to maintain its SSSI and SAC features in the longer term as demonstrated by the latest Natural England condition assessment.

Required water levels to maintain ecological features

4.43 In section 9 and 10 of Amec 2014f, AMEC quantify the hydrological requirements of the European features within the assessment cells. There are a number of problems with the methods used as described in section 5 below. Further to this, the reference points for water levels and soil moisture thresholds are configured using historic water level data. As discussed above, the historic water level data is not reliable. Further to this, it is certain (though not confirmed through survey) that the level of the fen surface, particularly on former turf ponded areas, has increased through natural successional processes. Therefore, water levels required to maintain the ecological features, are likely to be higher than they were in the past. This was described by Bryan Wheeler in an email to Natural England in 2003:

"...*as the [turf] cuttings mature, a higher water level may be needed in the dykes to keep them [the turf cuttings] as 'wet' as when they were 'young'. Thus water drawdowns today can potentially have a considerably more damaging impact upon the turf pond biota than a similar drawdown would have done one hundred years ago. Hence we cannot extrapolate simply from past water management practices to determine appropriate regimes for the present day*."

4.44 Therefore, ensuring water levels are similar to the pre-abstraction (i.e. naturalised) scenario, may be insufficient to maintain the condition of the ecological features. The increase in fen levels will necessitate higher water levels than in the past to maintain the features.

Comments on the successional process observed at SSSI Unit 3

Observations regarding historic change on SSSI Unit 3

4.45 Succession from a base-rich fen to a base-poor bog is well documented within European literature as a naturally occurring process[38]. Catfield Fen SSSI Unit 3 is currently undergoing rapid succession from a base-rich fen to a base-poor bog. This observation is supported by the various plant and vegetation surveys of Catfield Fen showing a variety of changes typical of this succession such as:

- An increase in plant species indicative of drier, more acidic, shadier and more Nitrogen-rich conditions;
- Rapid scrub encroachment;
- Rapid increase in *Sphagnum* moss cover;
- Reduction (and some loss) of species indicative of wetter, more base-rich conditions.

4.46 It is widely acknowledged that habitat management in the form of vegetation cutting and removal can slow this process of succession. However at Catfield Fen, there does not appear to be a link between management and succession. There are areas of the site that have been managed intensively for many years (such as the Mill Marsh reedbed) that have undergone succession from S24e rich-fen to BS5 Sphagnum bog, whilst there are areas where there has been minimal management where rich-fen persists (such as Mill Marsh East) and vice-versa. In general, the literature considers hydrology to be the most important factor affecting the rate of succession. For example:

- "obviously the hydrological conditions are dominant over the management regime in the long term", "the driving force behind the acidification of floating mires is water flow"[39]
- "This study has shown that changes in hydrology cannot be compensated for by increased management. It would therefore appear that, for the long term retention of a mire's ecological function, maintenance of hydrological integrity is of primary importance."[40]

4.47 Presently, at Catfield Fen, the majority of the peat at the surface is pH 5.0 to 6.0 (Appendix 9). These relatively low pH levels allow development of those *Sphagnum* species able to tolerate more alkaline conditions, through cation exchange, and continued infiltration of rain water and consequent depletion of bases, conditions eventually become suitable for bog *Sphagnum* species that require a lower pH. This process has been acknowledged as being a natural process, observed throughout Europe.[41]

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[38] Wheeler, B.J. (1982). Species richness of herbaceous fen vegetation in Broadland, Norfolk in relation to the quantity of above-ground plant material. Journal of Ecology 70: 179-200.

[39] van Diggelen, R., Molenaar, W.J., & Kooijman, A.M.(1996). *Vegetation succession in a floating mire in relation to management and hydrology*. Journal of Vegetation Science **7**: 809-820.

[40] Fojt, W., & Harding, M. (1995). *Thirty years of change in the vegetation communities of three valley mires in Suffolk, England*. Journal of Applied Ecology **32:** 561-577.

[41] Barendregt, A. (2014). Processes for fens and conditions on Catfield Fen. Catfield all Estate.

4.48 It is known that Catfield Fen receives base-rich groundwater from the crag aquifer[42] and the hydrological model reports a modelled lowering of water level by 4.1cm and a reduction in magnitude of upflow of 37% (from 12.8m^3/d to 8.1m^3/d) to cell G at Catfield Fen (though note separate RSPB concerns about the appropriateness and accuracy of the model in section 5). Rich-fen vegetation can persist for much longer under conditions of upwelling groundwater and "*if fens stay in contact with base-rich surface water, their life expectancy is much higher […] succession from rich fen to poor fen is then relatively slow*"[43].

4.49 For these reasons, it is highly likely that groundwater abstraction has, is and will continue to increase the speed of the natural succession processes and it is possible that groundwater abstraction is the driving factor behind the observed changes. Without historic abstraction it is likely that the vegetation at Catfield would be at an earlier stage of succession more typical of other fen sites in the Broads and that the site's conservation value would be maintained for a longer period before the natural processes of succession take hold.

4.50 This is of particular relevance to fen orchid (*Liparis loeselii*), for which the site is the most important in the UK (Plantlife, Pers. Comm., 2014). Fen orchid is known to be a species characteristic of early successional rich-fen and is noted as under threat from accelerated succession: "The decreasing of abundance of many species characteristic for wettest parts of moderately rich fens and initial succession states of development was found out […] *Carex dioica*, *Liparis loesilii*, *Utricularia intermedia*, *Sphagnum obtusum*, *Drepanocladus vernicosus* as the most affected species"[44].

Potential for restoration of rich-fen conditions at Catfield fen

4.51 It is clear from the discussion above that an increase in vegetation management would not be successful in reversing the successional processes at Catfield Fen without a restoration of the hydrological conditions. However, despite accelerated succession taking place on SSSI Unit 3, it is possible that restoration could still take place. There are records of successful regeneration of acidified rich-fens, but only in situations of upwelling of nutrient poor groundwater. Therefore, the longer local water abstraction continues near this site, the less likely that efforts to restore the site can be successful.

4.52 Although no literature can be identified citing any successful examples, turf ponding is often cited as an alternative mechanism for restoration of rich-fen sites that have undergone a transition to poor bog. However, once again it is clear that this is only likely to be successful with restoration of hydrological conditions. This is demonstrated by the following:

- At Catfield Fen, four turf ponds have been dug since 1992. The two larger, deep ponds dug in 1994 and 2011 in Sedge Marshes and Mill Marsh West respectively have so far developed poorly. The former has in-filled slowly from the edges with a monoculture of

[42] Amec (2014). *Site management technical note*. Amec.

[43] van Diggelen, R., Molenaar, W.J., & Kooijman, A.M.(1996). *Vegetation succession in a floating mire in relation to management and hydrology*. Journal of Vegetation Science **7**: 809-820.

[44] Navratil, J., & Navratilova, J. (2007). Wetland succession in Ruda Nature Reserve, Czech republic. In, Oruszko, T., Maltby, E., Szatylowicz, J., Swiatek, D., & Kotowski, W. (2007) *Wetlands: Monitoring, Modelling and Management. Balkema – Proceedings and Monographs of the Engineering, Water and Earth Sciences*, Taylor Francis, London.

reed swamp and the latter has to date developed little vegetation at all. Both have pH of 6 – 6.5 (See Appendix 9) which is unlikely to allow development into a valuable rich fen community.

- In 2008 two small turf ponds were hand dug in Hubbard's marsh, these pools have re-colonised with poor-fen vegetation almost indistinguishable from the surrounding poor-fen. A species poor composition of predominantly *Phragmites australis*, *Calamagrostis canescens* and *Cladium mariscus* persists with a ground layer of *Sphagnum* spp. moss. The development of this poor-fen community within these relatively new turf ponds indicates that efforts to restore larger areas of rich-fen through turf ponding will be unsuccessful unless underlying changes to the fen are able to be addressed. This poor re-colonisation of recently dug turf ponds is not surprising given data presented in Appendix 9 that demonstrate that away from dykes, acidic water dominates at Catfield Fen, both at the surface but also at depth (an apparent change from Giller & Wheeler, 1986[45]).

4.53 The RSPB consider that whilst continued turf ponding may be of considerable value to provide wetter conditions for invertebrates and potentially short term habitat for some early successional plant species (such as *Utricularia intermedia* and *Chara* spp.) it is highly unlikely that turf ponded areas will restore valuable rich-fen communities whilst the hydrology of the site is affected by local water abstraction.

4.54 In order for turf ponding and regular cutting management to be successful in restoring calcareous fen at Unit 3, restoration of hydrology is necessary.

Conclusions regarding observations of succession on SSSI Unit 3

4.55 The RSPB believes that the observed changes occurring at Catfield Fen SSSI Unit 3 are driven by hydrological change caused by local water abstraction and this reflects the process described in Barendregt 2013b[46]. Barendregt's conclusions are based on different data sets (from the Catfield Hall Estate) and with the background of a wealth of experience working on apparently similar processes in Holland, but that mirror the deterioration observed on SSSI Unit 3.

[45] Giller, K.E., & Wheeler, B.J. (1986). *Past peat cutting and vegetation patterns in an undrained fen in the Norfolk Broadland*. Journal of Ecology **74:** 219-247.

[46] Barendregt, A. (2014). *Processes for fens and conditions on Catfield Fen*. Catfield all Estate.

Overview of site management of SSSI Unit 3

4.56 During the renewal process for abstraction licences 7/34/09/*G/0141C and 7/34/09/*G/0144B the views of Butterfly Conservation and the RSPB on current or past site management within SSSI Unit 3, specifically relating to the abstraction renewals, were not incorporated into the Site Management Technical Note by Amec (2014). The Amec report was reviewed by the Catfield Hall Estate (Parmenter & Riches 2014), which highlighted many inaccuracies regarding the understanding of site management at Catfield Fen. The Environment Agency has acknowledged errors in the Site management technical note:

"*It is recognised that a number of the assumptions made within the Amec (2014e) technical note have since been shown to be incorrect*."

4.57 The Environment Agency report also acknowledges that the site is well managed:

"*As recorded in EA responses to consultation issues identified by NE and BA, the EA does not rule out the possibility that land management could have an effect on changes in vegetation. However, given that NE has concluded that the site is being well managed in accordance with the High Level Stewardship Scheme, we do not consider that it is necessary to consider this in more detail*."

4.58 However, given the focus of the EA statements is directed towards the management of the Catfield Hall Estate land, the RSPB has presented information regarding the management of the SSSI Unit 3. This report is the most comprehensive assessment of land management at Unit 3 available and includes an assessment of the relationship between the observed changes and land management.

4.59 The available literature on the subject of autogenic succession from rich-fen to poor-bog conditions strongly suggests that this process is occurring at Catfield Fen. Good land management practices and an appropriate lack of sluice operation are not preventing this process. It is widely agreed that the most important factor that affects the rate of succession of former turf ponds is the hydrology. It is the RSPB's view that water abstraction is affecting the hydrology of Catfield Fen by reducing both water level and flow and this abstraction is almost certainly accelerating the natural successional process leading to more rapid loss of SSSI, SAC, SPA and Ramsar features.

4.60 Intensive land management on parts of Catfield Fen is not slowing the successional process in those areas. Changes to sluice operation are not considered suitable due to the long history of a lack of operation, concerns about elevated nutrients in the external system and doubts about effectiveness of connection to water that is often lower in level and in pH. Increase sluice operation would, at best, be a mitigation measure to attempt to justify continued abstraction. Past attempts at turf ponding have been unsuccessful and it is unlikely that they can succeed without restoration of the site's hydrology.

4.61 The RSPB considers that local water abstraction is adversely affecting the integrity of the SSSI, SAC, SPA, Ramsar. This is demonstrated by the ecological changes documented in this chapter and in additional reports. Restoration is unlikely to be possible whilst water abstraction near to this site continues.

5. The RSPB's comments on the groundwater model

5.1 The groundwater modelling for the Catfield case has been scrutinised very carefully by a range of experts, for example, Barendregt[47], and Rushton[48]. The RSPB notes the various comments that have been made by Professor Rushton and the response that EA have made. It appears that many of the issues raised have been resolved. However, the RSPB considers that the key issues for conservation on the fen have still not been adequately addressed. Whilst the modelling gives an indication of the contribution of the crag water to the fen, it cannot be considered to provide a definitive representation of the water regime at or near the surface. Consequently, doubt remains regarding the robustness of any conclusions that can be drawn from the modelled outputs, especially for a complex site such as Catfield Fen and a precautionary approach must be adopted.

5.2 While generic assessment tools developed for the Habitats Directive Review of Consent and the Review of Sustainable Abstraction programme are helpful, it should be acknowledged that they cannot always provide the appropriate level of assessment for extremely sensitive protected areas like Catfield Fen. Whilst a consistent approach has been stated to be important, for complex sites like Catfield this does not replace the need for more detailed bespoke assessment and an appropriate application of the precautionary principle.

5.3 The RSPB has little knowledge of Snipe Marsh, but many of our concerns below relate to the assessment of this site as well, specifically concerns regarding the model parameters and outputs, and the link to ecological impacts.

RSPB comments on terminology used in the report

5.4 The use of the term 'water level' within the report is confusing, as it is used to mean different things. To improve understanding of the model inputs and outputs, clarity is required over this term. The RSPB recommends that the term 'water table'[49] (phreatic surface) be used to denote the level measured in the dipwells and where referring to water tables, whilst 'head'[50] be used for water levels in piezometers or screened wells. These terms have very specific meanings in hydrology and assists in understanding of the report discussion.

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[47] Barendregt, A. (2014). *Processes for fens and conditions on Catfield Fen*. Catfield all Estate.

[48] Rushton, K. (2014) *Comments on the revised GW Report*.

[49] **Water table:** Surface of a body of underground water below which the soil or rocks are permanently saturated with water. The water table separates the groundwater zone (zone of saturation) that lies below it from the zone of aeration that lies above it. The water table fluctuates both with the seasons and from year to year because it is affected by climatic variations and by the amount of precipitation used by vegetation. It also is affected by withdrawing excessive amounts of water from wells or by recharging them artificially. From Merriam-Webster online 9th December 2014: http://www.merriam-webster.com/dictionary/water%20table.

[50] **Head:** (a) a body of water kept in reserve at a height; *also*: the containing bank, dam, or wall; or, (b) a mass of water in motion. From Merriam-Webster online 9th December 2014: http://www.merriam-webster.com/dictionary/head.

RSPB comments on the model

5.5 The modelling used in the AMEC and Environment Agency reports is based on well developed physics which is widely used by hydro-geologists. Successful modelling depends on clearly identifying appropriate boundary conditions for the flow and using appropriate values for the model parameters in particular the hydraulic properties of the permeable layers through which the water flows. Modelling the complex surface and groundwater hydrology at Catfield Fen must inevitably make assumptions about the system and while there is a reasonable knowledge of the geology it is not clear that the hydraulic properties have been measured directly. It appears that average values have been applied to this multilayered system and that may lose some of the subtlety of the flow regime. Boundary conditions for flow are not explicitly stated except for the assumption of a radial vertical equipotential for the assumed radial flow model for the AWS Ludham well. Professor Rushton has rightly given this particular attention. Modelling with a simplified boundary condition and averaging the layered properties of an anisotropic medium the system is highly contrived and boundary and parameter values appear to be adjusted to fit model output to the measured pumping rate and drawdown measurements. The value of 1000 for anisotropy has been chosen because it gives what the modellers consider the best fit to measured data. This value is very high, for instance in the IILRI publication 47 (1994) it states (page 16) "*In horizontally-stratified alluvial formations, the Kh/Kv, ratios range from 2 to 10, but values as high as 100 can occur, especially where clay layers are present*". We note that the value chosen is an order of magnitude higher than this and we also note that estimated vertical flow will be less with this value than if a smaller value was used.

5.6 Noting the above caveats, the modelling work provides an estimate of the upward flow into the base of the upper peat layer. This is used to allow estimates of the water table in the upper layer. The different scenarios show that the naturalised system has a higher water table than the scenarios with partial or fully licensed pumping.

5.7 The simulations all show upward flow although at some locations this is almost negligible. In section 10.4 the acceptable levels of abstraction are discussed. In drought years values of the upflow from the crag is estimated from the model (page 179 of the main groundwater). For example:

Cell G – "The magnitude of upflow, and the difference between scenarios, is relatively small, average naturalised upward flow is 12.8 m^3/d (0.32 mm d), historic abstraction reduces the average upward flow to 9.4 m^3/d (0.235 mm/d), current fully licensed abstraction reduces upward flow to 8.1 m^3/d (0.203 mm/d)."

Cell H – "The magnitude of upflow, and the difference between scenarios, is relatively small, average naturalised upward flow is 33.2 m^3/d (0.83 mm/d), historic abstraction reduces the average upward flow to 28.6 m^3/d (0.715 mm/d),current fully licensed abstraction reduces upward flow to 26.5 m^3/d (0.663 mm/d)."

5.8 Clearly the water abstraction has an effect. The term 'relatively small' does not make it clear what the values are relative to.

5.9 We note that there are differences in upflow between these cells, although they are spatially close to each other (see EA Draft Determination Report Fig 9.2). Whilst the upward flows are considered to be small, the difference between scenarios on a percentage basis is not small. To put these upflow values into context the evapotranspiration (ET) in the summer months may be greater than 3 mm/d and open water evaporation would be greater than 4 mm/d. In a dry (drought) period, therefore, the water table in the peat/upper layer would be expected to fall and the upflow would have only a small effect in maintaining water tables. In practice water tables are maintained by water fed from the channels. If there is no management of lateral water flow by sluice control and ditch water levels either the model may be underestimating upward flow or there is uncontrolled seepage laterally in the upper layer. Further investigation is required.

5.10 In places, the report on the groundwater modelling appears misleading. For example:

"*There are a series of shallow (1-1.5 m deep) dipwells at the Butterfly Conservation reserve, one of which has been equipped with a datalogger for a number of years. Although four of the dipwells are no longer monitored, section 6.4.2 has shown that water level variations at all dipwells were very similar. The data are insufficient to determine the direction of vertical groundwater movement, but it is expected to be upwards at this location. Figure 7.13b shows that the model simulates the groundwater monitoring data very well, including capturing many of the short duration peaks and troughs. The modelled water levels also show a small upward gradient, in line with expectations*."

5.11 The text does point out that changes were similar, but the actual values are different. This is important because it demonstrates lateral flow. It also states that the data are *"…insufficient to determine direction of vertical movement of water*." This will always be the case with dipwells, which give an estimate of the water table position, not the head at a particular point i.e. there seems to be a confusion between dipwells and piezometers. The text then throws in a comment about modelled water levels which has no relevance to the dipwells. Whilst the comment is likely made to reinforce the suggestion of vertical water movement from the crag this should not be made in a discussion of dipwells.

5.12 With regard to the models described in section 7 of the AMEC report Doc 9 and with graphical representation in the Appendix G of that report, the processes modelled are complex. While an overview is possible from what is written, the details are not always clear.

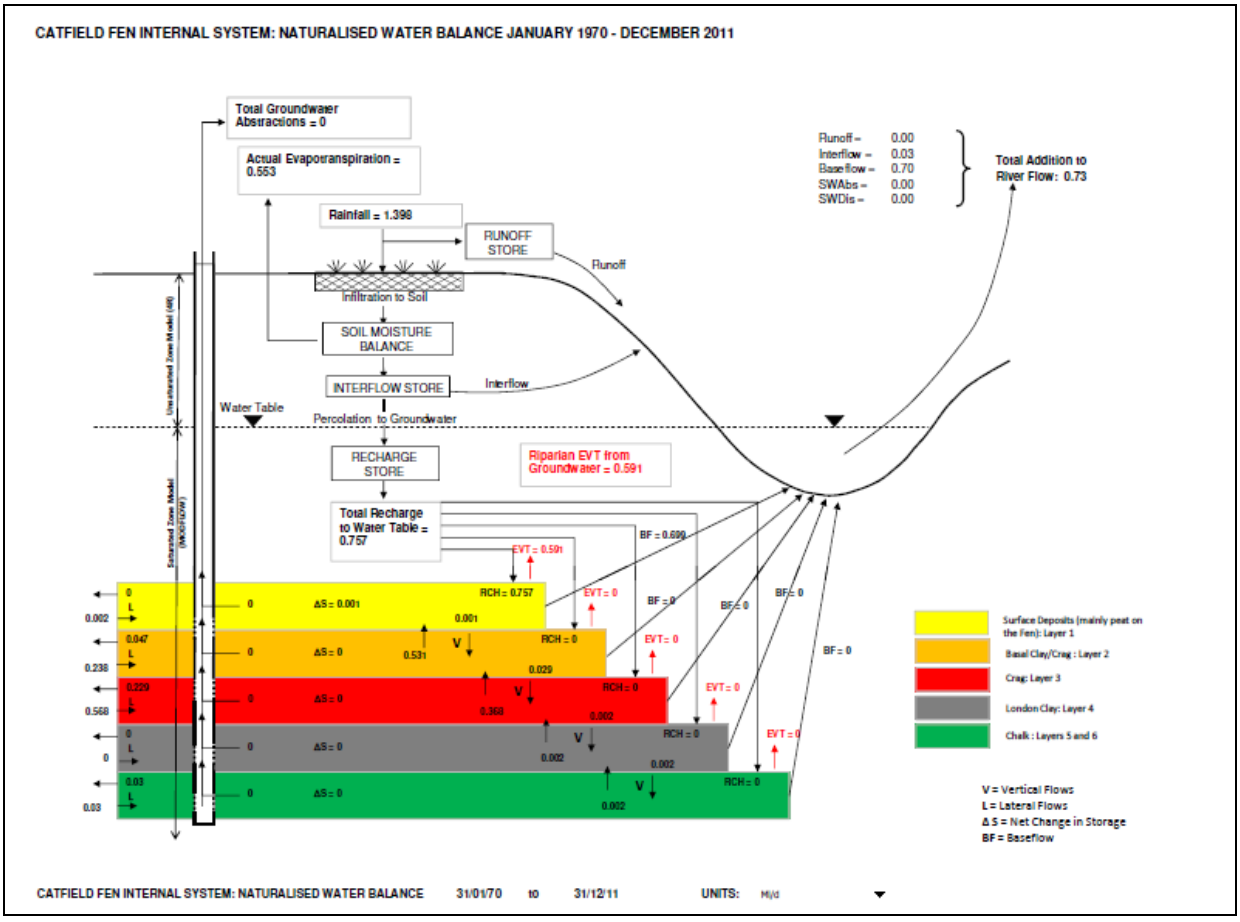
5.13 Actual evapotranspiration is given in the diagrams in Appendix G and recharge is also given. An instance for the naturalised system has defined no abstraction and no runoff and this is indicated in the figures for the 41 year simulation. The values in the diagram for the naturalised internal system for Catfield fen we take to be averages for the period and we take the units to be Ml/d. The annual evapotranspiration seems low and we do not understand why recharge is not the rainfall minus the ET (there is no runoff in these scenarios). The ratio of Rainfall to ET is 1.12 which is similar to the only data we have to compare against, which gives a ratio of 1.18[51]. The RSPB accepts that the weather/climate data may be more specific than the data we have explored, although there is no evidence of

[51] ADAS Reference book 434 (1982) Climate and Drainage pub. HMSO.

a long term weather station on Catfield fen. We acknowledge the short term University of Birmingham station that was in place during the 1990s.

5.14 For the average ET value shown the value is 252 mm/a, which is much lower than the ADAS average potential (reference) ET of 530 mm/a. The actual ET can be lower than the reference ET, which refers to a well supplied short grass stand, and this occurs when the upper soil layer dries. The RSPB does note that the internal system for Catfield Fen includes mineral top soils on higher elevations than the external system, so this may explain the figure. When the soil is wet the ET should be close to the reference value or even higher if there is tall vegetation and open or standing water. The rainfall is 638 mm/a, which is similar to the ADAS average annual figure of 623 mm for this area (see also table 3, Appendix 4 in Doc 40 in the Environment Agency files). Interflow is defined in the main report (p.107, Doc 9 in the Environment Agency files) and, on a physics basis, appears wrong. This appears to represent a store in the unsaturated zone and allows horizontal water movement in this zone above the water table. The flow to drainage laterally can only occur in the saturated zone below the water table and over a long term period we would expect the soil moisture change to be zero and net outflow and inflow to be the same in an undisturbed system. Using data in Figure 5.1 from the main groundwater report it appears that the recharge is 372 mm/a while the model shows 345 mm/a.

Figure 5.1: Diagram for the naturalised system over 41 year time span from Appendix G Doc 9.



5.15 The RSPB has to conclude that the interflow value is a used as a “fitting parameter”. It emphasises that the model has many parameters that cannot or have not been measured directly and are adjusted to allow model predictions to fit the sparse measured data set.

Assessing goodness of fit of the model outputs

5.16 There seems to be a lack of testing of goodness of agreement between the model outputs and measured data. Also no comprehensive sensitivity test to variation in parameter values is provided. This makes it difficult to critically evaluate the reports and to see the impact of abstraction on the status of the fen.

RSPB comments on the pump tests used to calibrate the groundwater model

5.17 Section 15.4 of the Alston determination report refers to pump tests used to inform the groundwater modelling and assessment. Reference is made to difficulties during the pump test and this raises the possibility of errors arising in the derived parameters which are crucial for the modelling of the groundwater hydrology. Recovery data was used to estimate aquifer hydraulic properties using a standard approach (Theis Recovery). The RSPB accepts that there are no indications that the analysis is in error based on the collected data, but the difficulties described above does pose the risk of inaccuracies being included within the assessment.

5.18 The AMEC pump testing technical note (Doc 4 2014) shows the methods used for analysis of the pumping data. The methods of analysis are standard and can be found in the IILRI manual 1994. In reviewing the pump testing technical note, however, AMEC seem to have assumed isotropic conditions (see AMEC Doc 4 table 1). It is not clear whether any further analysis assuming anisotropic conditions was undertaken.

5.19 Appendix 5 (Figures 1 to 3 in Doc 40) show contours of the head during the pumping. The contours are notional, as there are insufficient data to give accuracy and the lines are based on an assumed cone of depression. The RSPB considers that using these data to draw any conclusions is extremely difficult, if not impossible. However, the data do indicate that the effect of earlier pumping remains even when there has been no pumping, but the situation is complicated in that Fig 1 refers to March and Fig 2 to July when there is a much higher environmental water demand. An understanding of water requirements for the SAC/SSSI is required during the main growing season as this will be when plant water requirements are greatest and any reductions in water availability will be of greatest effect on the condition of the designated vegetation communities.

Groundwater model consideration of runoff from the crag

5.20 Whilst this may not be included in the computational model it is shown as a factor in the winter in fig 6.5 of main groundwater report. It is important that a model that includes such processes as runoff should not be confined to just the winter months. The RSPB would like to see that all the processes influencing the surface water hydrology should be included for all times not just for winter or summer situations.

RSPB comments on the water chemistry assessments to understand impact on pH

5.21 The RSPB accepts that there remain uncertainties regarding the influence of groundwater on pH levels across Catfield Fen. The pH data given in Fig 4.5 of the main groundwater report shows considerable variation, presumably both spatial and temporal variation is included in the data set. The RSPB notes that the number of samples is very small. For instance, the peat has only three values with a median pH of about 5.9 (acidic) and the river and broads has three values with a median at about 7.9 (alkali). It suggests that small predicted changes are difficult to interpret over the whole area.

5.22 It should also be noted that, the approach seems to have assumed pH (hydrogen ion concentration) can be treated like a conserved tracer. This may not be valid because the peats in the Ant valley have a wide range of pH values. The RSPB accepts that inflow of base-rich water from the crag will raise pH and that rainfall may lower it, but where there is a fluctuating water table oxygen entering the system can also create acidity. As a result pH can vary greatly seasonally with changes greatly in excess of 0.1, as highlighted by the data presented in Figure 4.5 in the main groundwater report. Field testing to draw conclusions and overcome uncertainties within the modelling is required.

5.23 As pH will also vary spatially, sampling variation needs to be accounted for.

5.24 The RSPB supports the need for this to be reviewed with Natural England to determine the significance of even small changes in pH on the interest features of The Broads SAC, the Broadland Ramsar and the Ant Broads and Marshes SSSI.

Comments on the soil moisture technical note [Amec 2014]

5.25 The AMEC soil moisture technical note lays out the water flow processes within the upper layer. This can be summarised by a simple water budget for a fen compartment which can be written as:

$$\sum_{t1}^{t2} R - E + V \pm L \pm \Delta Hs = 0$$

where
t1-t2 is the time period over which the water budget occurs
R is rainfall in the time period
E is the evapotranspiration in the time period
V is the vertical seepage from groundwater (influenced by pumping from wells)
L is lateral seepage into or out of the compartment
ΔH is the change in water table height in the time period
s is the specific yield of the layer in which the water table resides.

5.26 If the components for this equation are all known except the change in water table height then water table variation can be found. In the summary report emphasis is on estimating the vertical flow as influenced by pumping. It is the Soil Moisture technical note that addresses the fluxes above the water table. The approach here is again approximate because hydraulic properties have not been measured directly but values used have been taken from other sites published in the literature.

5.27 There are some misunderstandings in the text of the soil moisture report. The material at the surface is not in soils terms referred to as a soil but should be referred to as a peat. The term 'Peat Soil' is probably wrong for this fen site. We found the presentation of water release characteristics (fig. 4.1) to be difficult in terms of the arguments being put forward. Essentially the report makes clear that the upward flux (capillary rise) from the water table is limited by the unsaturated hydraulic conductivity of the peat. The maximum flux is of course when the peat is saturated which will occur above the water table when the capillary fringe extends to the rootzone or the soil surface. The flux will not exceed the atmospheric demand or evapotranspiration.

5.28 The capillary rise (distance not a flux) referred to in the report appears to be the distance from the water table to the soil surface. In practice the sink for water rising in the peat above the water table has a sink within the rootzone of the plants growing on the peat and is not at the soil surface. This probably means that the capillary rise flux from the water table could be greater than that estimated in drought conditions.

5.29 It is noted that the graphs of measured water table against modelled data for the historic period from 1961 to 2011 are more detailed than in the summary report (fig. 5.2 to 5.6).The agreement between modelled data and the dipwell measurements is good but poor for the gauge board in open water. As the report is dated 2014 and levels are given in mAOD it is assumed that any previous error has been corrected. This being the case we see that the measured water table at the gauge board is always higher than the level in the dipwells. This suggests that water is supplied to the fen even in summer and this constitutes lateral seepage into the fen. It is not clear that this is taken into account in the modelling.

6. RSPB position regarding the abstraction licence renewals impacts on the Catfield Fen component of the Broads SAC

6.1 The RSPB supports the Environment Agency's "minded to" decision to refuse to renew the Catfield water abstraction licences. The RSPB considers that insufficient information has been presented to demonstrate that the water abstraction licences are not and will not continue to contribute to adverse impacts on the Ant Broads and Marshes SSSI component of The Broads SAC and Broadland Ramsar sites.

6.2 The RSPB agrees with the Environment Agency's conclusion that an adverse effect on the integrity of the European sites cannot be ruled out and that consent for the abstraction licence renewals should be refused. However, we are disappointed that despite the considerable weight of evidence regarding the deterioration on the site and the rate of change regarding the spread of Sphagnum *spp*. being exceptional, Catfield Fen has not been concluded to be at risk of being adversely affected by water abstraction (as highlighted by the NE threat levels and change in site condition to unfavourable declining).

6.3 The RSPB accepts that there are uncertainties around impacts on the Snipe Marsh area of the SAC, but we consider sufficient evidence exists to demonstrate that the available information means it is also unable safely to conclude no adverse effect on Catfield Fen component of the SAC. Below the RSPB summarises the information we consider supports our position. This information strengthens the Environment Agency's case regarding the need to refuse the licences. Areas covered are:

- The RSPB's position regarding site and water management and their influence on the deterioration on Unit 3 of the Catfield Fen component of the SAC
- Policy and legal considerations
- Other matters

Policy and legal considerations

Complying with the Habitats Regulations

6.4 The Environment Agency has concluded that a risk of an adverse effect on the Broads SAC and Broadland Ramsar sites cannot be excluded. On this basis the Environment Agency can only consider granting a consent if it can be proven that the water abstraction licences pass the strict sequential tests set out in Regulations 62 and 66 of the Habitats Regulations (detailed in section 2 of the RSPB's response above):

- Ensuring there are no less damaging alternative solutions to the project(s) proposed;
- Demonstrating that the public benefits of the project(s) outweigh the need to protect the international importance of the affected European Sites (i.e. that there are "imperative reasons of overriding public interest" (IROPI) to proceed); and
- Providing necessary compensatory habitat to protect the overall coherence of the Natura 2000 network.

6.5 It is important to consider the relevance of the alternative solutions and IROPI tests given that in the decision-making process they are precursors to any consideration of compensatory measures.

Alternative solutions

6.6 The RSPB notes that the Environment Agency has considered a total of 10 alternative solutions, broadly divided between restrictions on the existing abstractions and alternative sources of water. However, the RSPB does not consider that this range of alternative solutions has been adequate. The RSPB disagrees with the statement that "The EA are only able to consider options that are within our control." This does not properly reflect the requirement of the Habitats Regulations, which requires the consideration of alternative solutions to go beyond the regulatory powers of the EA. Whilst we appreciate that the Environment Agency are keen to keep the consideration of alternative solutions to those that they have power over, it is important to note that the Habitats Regulations have no such restriction. Alternatives to the scheme being applied for should be evaluated by reference to what the applicant is seeking to do: further alternatives would include the growing of alternative crops which do not require the water abstraction licence to irrigate them, or the retailer sourcing the same crop from a different supplier. There is no such consideration here.

6.7 We have considered the alternative solutions proposed by the Environment Agency in Section 5 of the Addendum to the Appropriate Assessment and offer the following comments:

Table 6.1: RSPB comment on the Environment Agency's consideration of alternative solutions

EA reference	EA's Proposed approach	RSPB comments
5.1.1	Reducing the authorised abstraction quantities or number of hours pumped per day	The RSPB notes the comment that a reduction in the authorised quantity would be unlikely to sustain the applicant's existing business i.e. a private as opposed to a public interest objective. We note that this would provide the applicant with more water than an outright refusal, but we consider that the problems highlighted in 5.1.2 below would be applicable here, providing additional reasons why this is not an appropriate alternative. The RSPB is concerned that a reduction in the number of hours pumped would be simply be offset by greater pumping effort in the hours that are pumped. Few safeguards to ensure the designated site would be provided by this option.

EA reference	EA's Proposed approach	RSPB comments
5.1.2	A cessation condition could be added to the current abstraction linked to water levels (ideally using an observation borehole on site) to indicate when abstraction must reduce and/or cease	The EA has identified a number of problems with trying to implement this alternative. We agree with these observations and the EA's decision not to consider this option further.
5.1.3	A compensation discharge condition added to the current licences	The RSPB agrees with the EA.
5.1.4	Issuing a short term renewal pending the conclusion of the Restoring Sustainable Abstraction Investigation	The RSPB notes the conclusions of the EA's appropriate assessment of the current licence application. Given these conclusions, we do not consider that a short term renewal can be considered to be a suitable alternative approach and agree with the EA's conclusion at point 3.
5.1.5	Abstraction of de-minimus quantities	The RSPB notes the EA's conclusions.
5.2.1	Surface water abstraction	The RSPB welcomes the reference to the construction of a winter storage reservoir. We do not consider that the reference to the significant financial investment is a material reason to discount this approach as it provides a clear functional alternative to the abstraction which we consider that the applicant should pursue. In line with previous Government decisions and EC Guidance, such financial considerations should not be factored in at the alternative solutions stage. We note that other land owners in the area have successfully introduced such facilities and we are not aware any reason why it would not be appropriate here.
5.2.2	Relocation of the groundwater abstraction	The RSPB notes this possible alternative. However, given existing constraints on water abstraction in the Broads as a whole (particularly through the considerations of alternative public water supplies for the Greater Norwich area), we are not convinced that this will be a feasible alternative. The potential impacts of any alternative groundwater abstraction location will also need to be considered under the Habitats Regulations.
5.2.3	Deepening of the borehole into the chalk (a separate source of supply)	The EA has noted that the chalk supply is not separated from the overlying water. Consequently this approach would not be an acceptable alternative.

EA reference	EA's Proposed approach	RSPB comments
5.2.4	Water trading opportunities	We note this suggestion. However, given the inability to consider this approach before 2020 we do not consider that this is a realistic alternative at this time. It would not prevent ongoing deterioration to The Broads SAC during the intervening period.
5.2.5	Mains water	We note the cost implications flagged. However, it could be a feasible alternative solution to the licence application as it provides the water necessary for the growing of salad crops (noting the caveat regarding public water supply issues in 5.2.2). In line with previous Government decisions and EC Guidance, such financial considerations should not be factored in at the alternative solutions stage.

6.8 In section 5 of the Addendum to the Appropriate Assessment (under section 39 Environment Act) the Environment Agency accepts claims that refusal of the license renewals will have a very detrimental impact on the applicant's farming activities. This will only be the case if the applicant fails to use any of the alternative sources of water that have been identified which could maintain viable agriculture while eliminating risk to the sites, particularly winter storage reservoirs. There has been ample time to properly consider these alternative solutions over the last 5 years since the extension to the abstraction licences was granted.

6.9 In considering alternative solutions the Environment Agency should also have considered the suitability of the applicant's chosen abstraction dependent cropping in such a sensitive water environment. Alternative crops that can maintain viable agriculture in the area would be appropriate under the Habitats Regulations. This does not appear to have been discussed with the applicant.

6.10 The RSPB is also aware that there is currently a problem at Hand Marsh (SSSI Unit 30) due to poor quality water being input into the SSSI. We consider that it may be possible to use this water as an alternative supply for the irrigation of the fields currently the subject of this licence. This would have the twin benefits of ensuring the protection of the designated sites from the risk of harm from further abstraction as well as helping to address an existing problem at Hand Marsh. We recommend this option, or any other similar proposals be reviewed by the Environment Agency, Natural England and the applicant.

6.11 In summary, credible, feasible and less damaging alternative solutions exist to the proposed water abstraction licences.

Imperative reasons of overriding public interest and compensatory measures

6.12 The RSPB does not consider the Catfield abstraction licences meet the tests for an IROPI case. The issue of compensation is therefore not necessary. However, given the rarity of the interest features at risk from continued water abstraction at Catfield (e.g. Fen Orchid), the RSPB consider it extremely unlikely that appropriate compensatory measures could be secured that would maintain the overall coherence of the Natura 2000 network.

Ramsar consideration

6.13 In reviewing the information compiled to inform the EA's "minded to" decision it does not appear that substantial weight has been given to the Ramsar designation, although it is Government policy to afford Ramsar sites the same level of protection as European sites (see section 2) The Ramsar citation is not included within the document library and limited mention is made to this designation throughout the draft determination report and Appendix 12. We recommend EA reviews this further in final decision.

6.14 The significant deterioration in quality of the calcareous fen community and the adverse effect this is having on the fen orchid population on SSSI Unit 3 is of serious concern. Given that Catfield Fen support over 50% of the known UK fen orchid population (see section 3) and is the key site underpinning the condition of this feature in the entire Broadland Ramsar designation, failure to take action to prevent further deterioration of this feature at an international level is important.

Observations regarding Water Framework Directive (WFD) considerations

6.15 Section 9.1 of the draft determination report reviews the Broadland Rivers Chalk and Crag Groundwater Body, a feature of consideration under the Water Framework Directive. Although the Broadland Rivers Chalk and Crag groundwater is currently classed as Poor, and the 2009 River Basin Management Plan (RBMP) does not expect it to reach target status before 2027, this does not automatically excuse activities that would damage it between now and 2027. This is for two reasons:

- The 2009 RBMP is only an interim summary of measures which – as Article 13 of the Water Framework Directive makes clear – 'shall not exempt Member States from any of their obligations under the rest of this Directive'. Within English law as well, the RBMP does not overrule the Environment Agency's ongoing duty (under Regulation 3 of the 2003 Water Environment Regulations) to 'secure compliance' with the Water Framework Directive. This includes:
    - meeting with each decision the overall sustainable use and environmental protection aims of the Directive set out in Article 1,
    - the need to justify time extensions under Article 4(4) on an ongoing basis – and even where extension can be justified,
    - to bring 'bodies of water progressively to the required status' – and,
    - the need to implement the basic and supplementary measures required by Article 11 to prevent damage to groundwaters.
- Extension of deadlines under Article 4(4) requires 'no further deterioration' in a water body. This includes 'within-class' deterioration; where a waterbody deteriorates but

does not change status class (see for example paragraphs 82-84, 100 and 110 of the Advocate-General's opinion in ECJ case C-461/13).

6.16 Altogether, the Environment Agency has a clear ongoing duty to ensure that each decision it makes is compliant with the Water Framework Directive – and not merely the 2009 RBMP – and this duty includes the need to prevent *any* deterioration of, and progressively to improve, the Broadland Rivers Chalk and Crag groundwater. In our opinion, failure to include Catfield Fen in the "minded to" decision does not adequately meet that duty.

6.17 The RSPB is also concerned that the EA considers the Review of Sustainable Abstraction (RSA) programme to be an acceptable mechanism to address the observed deterioration of the SAC and SSSI (as highlighted in Section 9.8 of the draft determination report). RSA is a long-term programme with a now uncertain mechanism for funding any change through compensation now that the Environmental Impact Unit Charge (EIUC) has been abandoned. We believe that sites within The Broads SAC, Broadland Ramsar and Ant Broads and Marshes SSSI are rapidly deteriorating now and cannot wait for further years of study and data gathering to possibly improve certainty before action.

The RSPB's position regarding site and water management and their influence on the deterioration on Unit 3 of the Catfield Fen component of the SAC

6.18 This section summarises the RSPB's position on key factors relating to Unit 3 at Catfield Fen, part of the Broads SAC. The RSPB considers these are highly relevant to the EA's 'minded to' decision. We set out the influence of those factors on the known deterioration of Unit 3 and its future prospects if abstraction is permitted to continue.

Implications of revised condition status for SSSI Unit 3

6.19 As highlighted in section 3, Natural England re-classified Catfield Fen SSSI Unit 3 as being in unfavourable declining condition on 27th October 2014. Of the three reasons for adverse change, water abstraction and change to habitat suitable for fen orchid are pertinent to the Alston licence determination process. The scrub encroachment is important for the site as a whole, but management measures are already addressing this threat and work will be continued through the life of the current management plan to ensure scrub is reduced to levels that are appropriate for the site. Natural England clearly consider water abstraction to be a potential cause of the rate of damaging change that is taking place on SSSI Unit 3 despite a history of continuous management.

6.20 The revised condition status is important as it is will require that measures are implemented to address the adverse change. Success will be dependent on maintenance of a suitable hydrological regime and the RSPB considers that sufficient evidence is presented to demonstrate that, despite concerns that the groundwater model is insufficiently precautionary[52], changes in alkaline inputs to SSSI Unit 3 could be significant. Ensuring

[52] Due to data limitations, the parameters used to fit the model to observed trends, the assumptions that have been applied to the model and the ability of the model to adequate capture and model complexities of the hydrological regime.

inappropriate levels of water abstraction are addressed will be essential in order to remedy the adverse reasons for SSSI Unit 3 being classified as in unfavourable declining condition.

Implications of historic and current site management on the condition of SSSI Unit 3

6.21 Section 4 highlighted that there has been a continuous history of habitat management at Catfield Fen since 1992. Management actions have been consented by directed and consented by Natural England. Management of SSSI Unit 3, 8, 10 and 24 has been identified as being comparable with management with other Broads fen sites and, for some measures (e.g. turf ponding), demonstrated higher levels of management intervention (Table 4.2). This level of management is due to continue under the current management plan and will be reviewed annually in order to ensure management continues to be appropriate to meet the objectives set out in the current and future management plans.

6.22 Of key relevance is the management around the fen orchid colony on SSSI Unit 3. The area where the fen orchid colony occurs has been consistently within commercial or non-commercial cutting rotations since at least 1996. Despite this, the area continues to become more acidic and *Sphagnum* moss continues to increase around the fen orchid colony. At no time since 1996 has this area fallen out of regular cutting management. It appears therefore that whilst management is known to slow successional processes, in this case it has not prevented the changes.

6.23 Given that the management outlined is comparable with other managed fens within the Broads it would be expected that similar rates of change would be seen elsewhere if a lack of appropriate management was causing the changes at Catfield Fen. Despite many well monitored sites, we are unaware of any other sites in the Broads undergoing such rapid succession.

Implications of historic and current water management on the condition of SSSI Unit 3

6.24 Section 4 documents as best as possible the historic use of the sluice on SSSI Unit 3, as well as current use. It can be demonstrated that there is some exchange between the internal and external systems, but this is limited. Management of the sluice to increase the exchange of water between the internal and external systems must consider the implications for the designated features of SSSI Unit 3. Natural England has overall responsibility for consenting any such action and the available evidence indicates a significant risk to the sensitive vegetation communities within SSSI Unit 3 if nutrient-rich water was allowed into the internal system. Increased nutrient levels are widely understood to be detrimental to wetland ecology (for example, see Barendregt 2014[53]) and the highly protected status of Catfield Fen SSSI Unit 3 requires that such damaging actions are not consented. Given the Site is already in unfavourable declining condition only actions that could be demonstrated to support recovery and maintenance of the site to favourable condition can be consented.

[53] Barendregt, A. (2014). *Processes for fens and conditions on Catfield Fen*. Catfield all Estate.

6.25 Although data is limited the RSPB is interested to note that the ditch water within the internal system appears to be more alkaline than the external, despite a much higher pH in the river (an average of pH 7.58 from 11 samples collected in December 2013). This could be indicative of the known crag groundwater input into the dykes to the east of Catfield Fen.

Limitations regarding the available water level data to assess trends on SSSI Unit 3

6.26 In section 9 and 10 of the main groundwater report, AMEC quantify the hydrological requirements of the European features within the assessment cells. The RSPB has identified limitations with the model that could affect the ability to reach robust conclusions on the hydrological model (section 5). In addition, the reference points for water levels and soil moisture thresholds are configured using historic water level data. However, there appears to be a lack of water level data post-1986 or long term "no pump" tests used to inform model outputs. In the absence of this, it is not possible to correctly model the natural water balance of Catfield Fen or to model the impact of abstraction. Critically, the absence of such data limits conclusions on the potential impacts of water abstraction on the alkaline water dependent habitats and species present on the site. Given this case is being assessed under the Habitats Regulations all information presented and conclusions must be able to link back to potential impacts on the integrity of the site (i.e. potential impacts on the conservation status of designated features). The RSPB considers this has resulted in the Environment Agency's conclusions being less precautionary in respect of Catfield Fen than they should have been.

6.27 The RSPB notes that Section 6 of the Appropriate Assessment (p.49, Appendix 12) states that:

"*The data from the monitoring installations provides information on the horizontal and vertical movement of groundwater level gradients, and the fluctuations of water levels both seasonally and over longer periods of time. The Environment Agency's assessment of the available hydrological data is that the data is extensive and of good quality*."

6.28 The RSPB disagrees that the data to determine trends in water level across the site are of "good quality." We have reviewed the data set for Catfield Fen SSSI Unit 3 and have been unable to complete a trend analysis due to limitations with the data (highlighted in section 4 above). There appear to be similar constraints on all other dyke and peat water level datasets within the internal system. The RSPB has requested the full water level dataset for comparison purposes but this has not been received during the consultation period. There is, therefore, no currently available data to identify water level trends within the internal system at Catfield Fen. Consequently, no conclusions based on water level data can be made to determine if there is or is not a drying trend at Catfield fen. Further investigation is required to understand any water level trends, especially where ecological evidence is emerging that parts of the site may be becoming too dry to maintain its SAC, Ramsar and SSSI features in the longer term (section 3).

6.29 Whilst the level of the fen surface, particularly on former turf ponded areas, may have increased through natural successional processes it should also be considered that the water levels required to maintain the ecological features, are likely to be higher than they were in the past. This was described by Bryan Wheeler in an email to Natural England in 2003:

"...as the [turf] cuttings mature, a higher water level may be needed in the dykes to keep them [the turf cuttings] as 'wet' as when they were 'young'. Thus water drawdowns today can potentially have a considerably more damaging impact upon the turf pond biota than a similar drawdown would have done one hundred years ago. Hence we cannot extrapolate simply from past water management practices to determine appropriate regimes for the present day."

6.30 Therefore, ensuring water levels are similar to the pre-abstraction (i.e. naturalised) scenario, may be insufficient to maintain the condition of the ecological features. The increase in fen levels will require water levels to be higher than in the past in order to maintain the features.

6.31 Currently, therefore, the RSPB considers the thresholds presented in section 9 of the main groundwater report are not sufficiently precautionary to determine no adverse effect on the European features. The thresholds cannot accurately be configured to actual water level within specific cells due to a lack of availability of reliable pre-abstraction water level data. In addition, the importance of successional processes at Catfield and in particular, any increase in surface ground level over time and the implication on water level requirements for European features present has not been quantified.

Information input of potential groundwater inputs to SSSI Units 3 (Catfield Fen) and 10 (Sutton Fen)

6.32 Section 6.6.2 (p.101) of the main groundwater report states that:

"The cross-sections indicate that the geology underlying Unit 3 is slightly different in that the clay layer is believed to be thicker and more continuous."

6.33 Whilst the clay layer may be thicker under SSSI Unit 3 than SSSI Unit 11 (Section 6.6.2 (p. 101) of the main groundwater report), the RSPB has received information that indicates springs are present within the fen (Appendix 10). Based on the available information, at least one area continues to be groundwater fed. Based on the anecdotal evidence, current flow from this area is considerably reduced from the historic situation. Surveys of the vegetation communities across the site support the presence of continued groundwater inputs. The main groundwater report appears to dismiss the potential for groundwater upwelling onto SSSI Unit 3 based on the available geological evidence collated by Amec.

6.34 In addition, it has been considered that groundwater inputs should also feed into Sutton Fen, especially SSSI Unit 10, again based on the ecological information. Recent sampling of the pH of pools within the system indicate that there are indeed pools within the site, isolated from the river, that have high pH readings (≥9). Further investigation is required to better understand the hydrological regime, but as with SSSI Unit 3, the features of Sutton Fen are highly sensitive to hydrological change and could be adversely affected by inappropriate levels of groundwater abstraction in the wider area if not carefully controlled.

6.35 It is not clear if such groundwater inputs have been considered within the current groundwater model assessment. If not then this should be addressed, as this indicates a direct link to alkaline upwelling, which could have direct implications for the integrity of SSSI units 3, 8, 10, and 24, all integral parts of the SAC.

Impacts on SAC features at Catfield Fen

6.36 Whilst the RSPB agrees with the overall "minded to" conclusion, we are concerned that this assessment does not apply to features on SSSI Unit 3 that are threatened by significant ecological change taking place. The RSPB has provided substantial evidence relating to fen orchid on the site (section 3, Appendices 3 & 4), as well as water beetles (section 3, Appendix 5). Fen orchid requires certain alkaline conditions to create and maintain the appropriate calcareous fen community that it depends on to grow. The observed changes on SSSI Unit 3 are placing over 50% of the UK fen orchid population at risk. Maintenance of the Catfield Fen population is therefore critical to securing its long term survival in the UK.

6.37 In addition the invertebrate assemblage for the site appears to have experienced negative change based on observations of the water beetle assemblage on SSSI Unit 3. This represents the best proxy for the invertebrate assemblage feature. The species that have been lost are dependent on appropriate water levels and water chemistry and these now appear to be lacking across parts of the site, including common and widespread species.

6.38 As a consequence, Natural England has amended the site condition status to unfavourable declining in part because of water abstraction and threats to the habitat supporting fen orchid. The national, European and international importance of the site for a range of habitats and species is increasingly threatened and the evidence presented in the main groundwater report is insufficient to demonstrate that the water abstraction licences are not adversely affecting this component of the SAC as well

Other matters

Importance of Sutton Fen and Catfield Fen for rare and scarce species compared to the RSPB reserves across the UK

6.39 In understand the RSPB's concerns for Catfield Fen and Sutton Fen, it should be noted that these reserves rank in the top three of the RSPB's reserve network for rare and scarce species. Many of these species, such as fen orchid, will be highly dependent on these reserves for their continued survival in the UK. Table 6.2 highlights the species numbers for the top three reserves. This is extraordinary given that Abernethy and Minsmere have a greater diversity of landscapes and vegetation.

Table 6.2: Top three RSPB reserves for rare and scarce species.

	Species	Species	Species	Species
Reserve	Threatened	Rare*	Rare or very scarce*	Rare or scarce*
Abernethy	107	223	282	783
Minsmere	50	72	118	413
Sutton Fen	49	78	98	257

* Rare means found (or thought to be) in 1-15 10km squares in Britain
** Very scarce means 16-30 10km squares
*** Scarce means 31-100km squares (in this table it includes very scarce too)

The contribution of Catfield Fen to the local economy.

6.40 The RSPB has stated its position regarding the use of economics to determine a case under the Habitats Regulations in section 2 of our response.

6.41 Although we do not think that any decision about the renewal of AN/034/0009/008 Plumsgate Road and AN/034/0009/009 Ludham Road should be influenced by economics, the RSPB notes that economic information will be reviewed by the Environment Agency. It is important to bear in mind that conservation and tourism also have an economic value. Although no attempt has been made here to quantify the economic value of many aspects of Catfield Fen (such as visitors, carbon storage etc), those figures that can be measured or estimated demonstrate that almost £500,000 has been contributed to the economy (mostly local) by the 24ha area of Butterfly Conservation's Catfield Fen since 1992.

Snipe Marsh

6.42 There is a paucity of data to inform accurate modelling of the conditions on Snipe Marsh. No formal monitoring of this site has been undertaken and assessments are largely informed by comparison of neighbouring areas that have been modelled using a greater volume of information. Whilst this may affect the parameterisation of Cell K, the best available data does appear to have been used, subject to any additional information from the landowner and the Broads Authority may present in their response to the "minded to" decision.

6.43 The Habitats Directive has strict tests that are set out to ensure that the best habitats and wildlife sites are protected. In the case of Snipe Marsh, sufficient information must be provided by the applicant to demonstrate that adverse impacts to the site features will be avoided. In order to achieve this, a robust monitoring programme will need to be implemented and data collected over a number of years to allow trends in the hydrological regime of the site to be assessed. The current information indicates a potential threat to the site and until such time as evidence is presented to demonstrate water abstraction is not damaging the site water abstraction licences should not be approved.

6.44 Consequently, the RSPB supports the Environment Agency's decision with respect to Snipe Marsh.

Monitoring requirements in the future to inform the impact of activities around the designated sites assessed for the Alston abstraction licences

6.45 Regarding Catfield fen, the RSPB and Butterfly Conservation are committed to restoring SSSI Unit 3 to favourable condition to ensure it continues to contribute fully to the SAC and Ramsar site. Considerable work has been done and will continue to be done to ensure management of the site is appropriate. However, in order to inform specific management and ensure the site remains one of the best sites in the UK for rare and scarce species, we will be commissioning further surveys to better understand the invertebrate assemblage, further enhance our understanding of fen orchid, further our understanding of the change in *Sphagnum* species across the site in order to identify actions to arrest the spread and undertake rigorous assessment of water chemistry, water levels, and water flows. Where site management through turf ponding occurs detailed monitoring will be undertaken to supplement existing data regarding re-colonisation and succession.

6.46 Whilst the RSPB and Butterfly Conservation will commit to such work, we consider it essential that appropriate support is provided by the Environment Agency and Natural England. We are keen to review the monitoring regime for the site to ensure it aligns with standard methodology that will enable the data to be compatible with other data sets held by EA and NE.

6.47 Vegetation communities S27 and M24 are both part of the SAC Transition Mire feature and Ppc, M9 and S24e are all known to support Fen orchid. Further survey work is therefore required to determine distribution of S24e, S27, M9, M24 and Ppc on Sutton Broad. Any change to these vegetation communities could have serious implications for the SAC, Ramsar, SSSI and other rare species that they support and they should all be assessed in relation to water abstraction.

6.48 Regarding Snipe Marsh, an appropriate monitoring regime must be implemented in order to better understand the site and inform discussions regarding water abstraction in this area in the future. This must be discussed with the landowner, the Broads Authority and Natural England.

Overall conclusion

6.49 *The draft determination report (p.46) states that:*

"The Environment Agency cannot conclude beyond reasonable scientific doubt no adverse effect from abstraction licences AN/034/0009/008 Plumsgate Road and AN/034/0009/009 Ludham Road on the Ant Broads and Marshes SSSI – component of the Broads SAC, Broadland SPA and Broadland Ramsar."

6.50 The RSPB supports this conclusion in principle insofar as it applies to the Snipe Marsh area of the SAC. However, for reasons set out in detail elsewhere in this submission and summarised below, we consider the draft determination report is incorrect in concluding no adverse effect from the abstraction licences in respect of the Catfield Fen and Sutton Fen components of the SAC and Ramsar site. Our reasoning for this position is:

- Site and water management across SSSI Unit 3 is too simplistic an explanation for the adverse changes taking place on the site (section 4),
- There is available evidence to indicate that the hydrological understanding of SSSI Units 3, 8, 10 and 24 presented in the main groundwater report and thus the model outputs likely underestimate the effect of water abstraction on these sites (section 4).
- The approach to the groundwater model assessment is based on a number of assumptions and inaccurate data that oversimplify the potential effects of the groundwater model predictions on Catfield Fen and, potentially, Sutton Fen (sections 4 and 5).
- The site features on SSSI Unit 3, notably Calcareous Fen, fen orchid, and a component of the invertebrate species community (aquatic coleoptera) are deteriorating and threatened by a changing hydrological regime that it is not possible to demonstrate is not affected by water abstraction in the wider area (section 3).

6.51 Within the main groundwater report there are indications that some uncertainty is retained by the authors as to the ability to separate groundwater abstraction from the deterioration of Catfield Fen. For example, the statement "it is difficult to see that abstraction has been the primary cause of the changes in *Sphagnum* spp. observed since 1986" (p.184 of the main groundwater report) does not rule out water abstraction as being a contributing factor to the spread of *Sphagnum* species and thus site deterioration. Percentage changes in upward flow under drought conditions indicate a significant proportional reduction in upflow that would not be conducive to supporting site recovery through site management alone. Restoration of the site to maintain SAC features, especially fen orchid, has to be the focus. Where it cannot be demonstrated that water abstraction is not contributing to adverse impacts on features of the SAC and SSSI then appropriate measures need to be implemented in order to maintain and, where necessary, restore the feature in the future. Greater precaution should be applied to SSSI Unit 3, and increasing evidence indicates that Sutton Fen should be considered in greater detail in the future based on recent information highlight strong groundwater alkaline inputs.

6.52 The RSPB also notes that the Environment Agency have applied their NEAC model in order to achieve consistency in their decision making process. However, when sites of the very highest ecological importance are at risk it is important that site-specific bespoke assessments are used (with a high degree of precaution) to understand impacts and protect the sites. We therefore do not share the EA's confidence in their NEAC groundwater model nor in their decision table methodology and do not believe they are precautionary enough. The RSPB has already stated in its review of the groundwater model that we do not consider sufficient evidence is presented to link the groundwater outputs with ecological change across the sensitive fen habitats of the these parts of the SAC (section 5). A growing body of evidence indicates significant changes to the ecology of SSSI Unit 3. No evidence to date is

able to demonstrate that water abstraction is not contributing to this change. The NEAC model as a tool provides information to help inform the hydrological situation of the area as a whole, but has significant limitations in informing the determination of the groundwater licences.

6.53 In addition, at Sutton fen, whilst the site may be currently classified as in favourable condition this does not excuse not taking appropriate steps to avoid deterioration by reducing the risk of groundwater reduction in the future. The current management of the site is maintaining the site at a very high ecological level. However, it must not be taken that there is a potential sacrificial threshold for the site based on exceeding of SSSI targets, as opposed to SAC objectives.

6.54 In making its final decision the RSPB strongly recommends the Environment Agency not only maintain its “minded to” position, but to further strengthen its decision through reference to the risks posed to the Catfield Fen area of the SAC in particular.